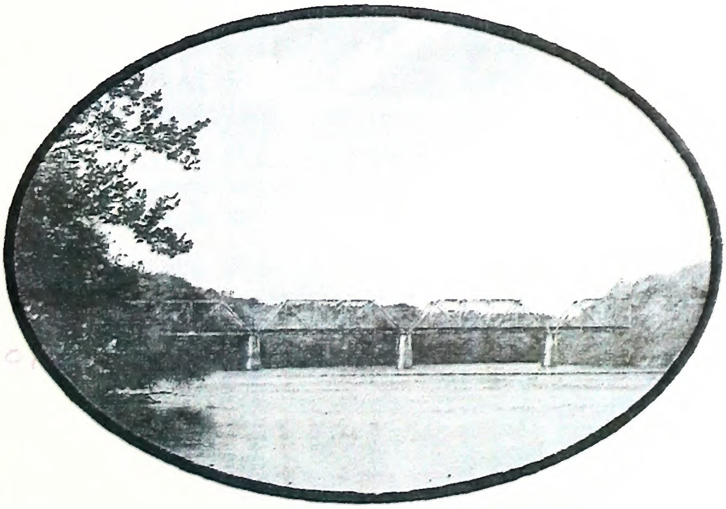
North Carolina Department of Transportation
Statewide Planning Branch
Systems Planning Unit

# THOROUGHFARE PLAN TECHNICAL REPORT



# LILLINGTON



October, 1998

# Thoroughfare Plan Study Technical Report
for
# Lillington, North Carolina

Prepared by the:
Statewide Planning Branch
Division of Highways
North Carolina Department of Transportation

In Cooperation with:
The Town of Lillington
Harnett County
The Federal Highway Administration
US Department of Transportation

October 1998

## Acknowledgments

Persons Responsible for this Report:

| | |
|---|---|
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| Systems Planning Unit Head: | Mike Bruff, P.E. |
| Statewide Planning Branch Manager: | M.R. Poole, Ph.D., P.E. |
| Project Technician: | Jocelyn Jones |

Special thanks to the officials of Lillington for their foresight and drive in developing this plan. Also, thanks to the Harnett County Planning Board for their assistance and commitment to long-range planning.

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## EXECUTIVE SUMMARY

### Overview

At the request of the Town of Lillington, the NCDOT began a thoroughfare plan update in 1995. Although recommendations were developed, a final plan was never adopted. This report documents the study to date. At the request of local officials, the study has been placed on hold.

The primary purpose of this report is to present findings and recommendations of the thoroughfare plan study conducted for the Lillington study area.

### Highlights of the Thoroughfare Plan

Major highlights of the 1996 Lillington Thoroughfare Plan are outlined below. The recommended improvements are shown in Figure 1. The Recommended Thoroughfare Plan Map is shown in Figure 2. Project numbers for those projects included in the 1998-2004 Transportation Improvement Program (TIP) are shown in parentheses.

1) US 401: widen existing roadway to a multi-lane facility from multi-lanes located north of Fayetteville to Fuquay-Varina as a future need. (TIP #R-2609)
2) US 421 Bypass: new route located in the southern section of the planning area to route traffic from US 421/NC 27 to US 421 North and US 401 (and along Main Street).
3) NC 210: upgrade NC 210 with multi-lane sections and two other lane improvements from Spring Lake to Lillington. (TIP #R-2230)

Refer to Chapter 4 and Appendix A for other recommendations.

### Implementation

The North Carolina Department of Transportation (NCDOT) and the Town of Lillington are jointly responsible for the proposed thoroughfare improvements. Cooperation between the State and the Town is of primary concern if the recommendations outlined above are to be successfully implemented.

It is important to note that the recommended plan is based on anticipated growth within the planning area as indicated by past trends and additional information supplied by the town agencies and Harnett County. Prior to the construction of each project, a more detailed study will be required to revisit development trends and to determine the specific location and design requirements for each facility.

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Refer to Chapter 3 and Appendix [illegible]

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2) US 421 Bypass, new route located in the southeastern section of the planning area [illegible] from US 401 (NC 27) to US 421 North and [illegible].
3) NC 210, upgrade NC 210 with widened sections and new other lane improvements from Spring Lake to Lillington. (TIP #R-2238)

Refer to Chapter 4 and Appendix A for further recommended actions.

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2) US 421 Bypass - new location [illegible] the planning area [illegible] US 421 [illegible] Main Street)
3) NC 210 - upgrade NC 210 with multi-lane section [illegible] Spring Lake to Lillington (TIP [illegible])

Refer to Chapter 3 and Appendix A for other recommendations.

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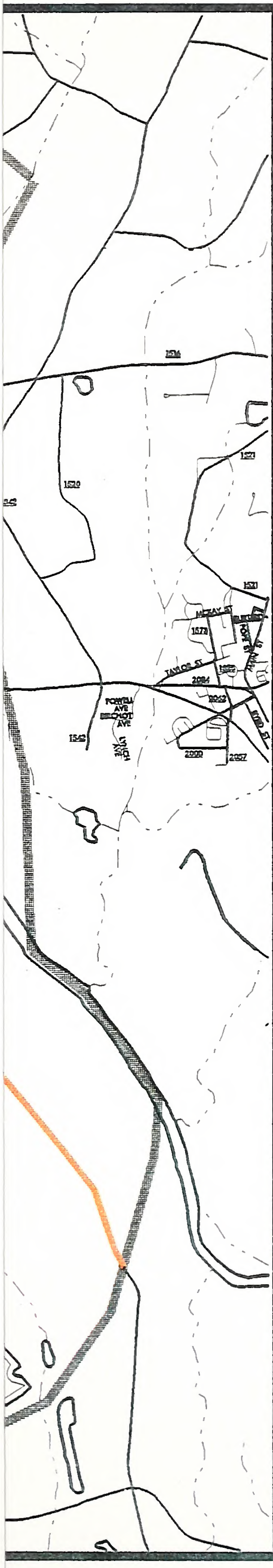


## LEGEND

Planning Area Boundary

| | WIDENING | NEW FACILITY |
| --- | --- | --- |
| 2 Lanes | | |
| 4 Lanes | | |

## Figure 1

# RECOMMENDED IMPROVEMENTS

# LILLINGTON

HARNETT COUNTY
NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - GIS UNIT

U.S.DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 2 4 6 8
miles

0 1 2 3
kilometers

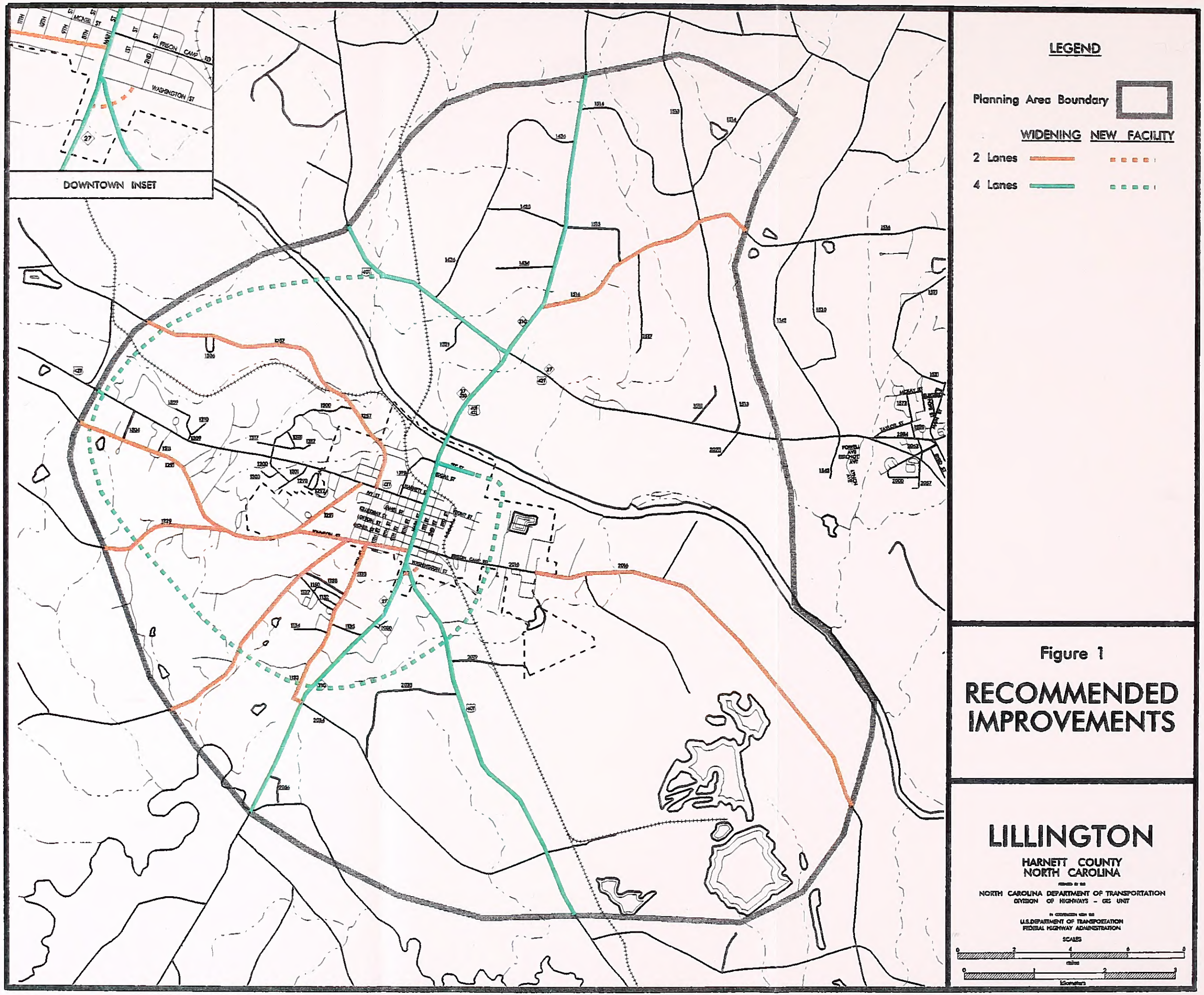
DOWNTOWN INSET
LEGEND
Planning Area Boundary
WIDENING NEW FACILITY
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Figure 1
RECOMMENDED IMPROVEMENTS
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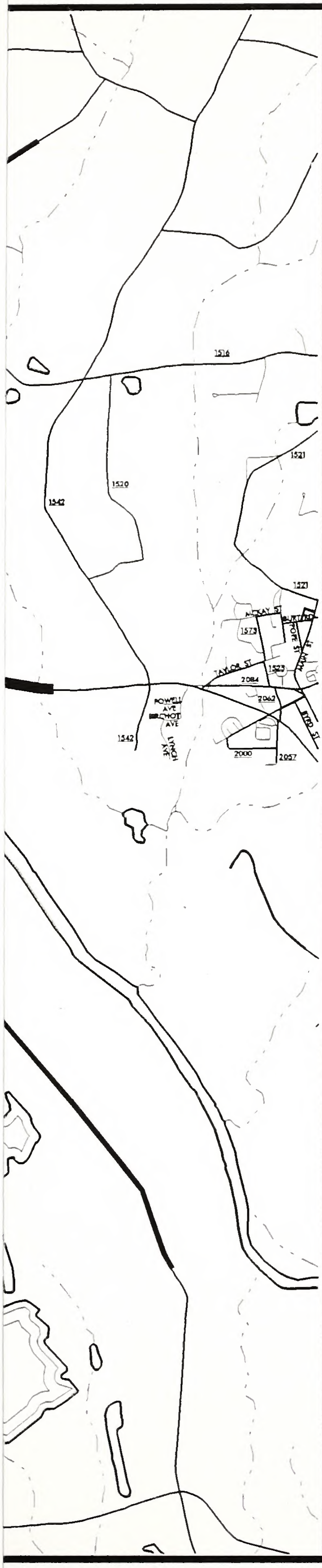


## LEGEND

| | EXISTING | PROPOSED |
|---|---|---|
| Freeway /Interstate | | |
| Major Thoroughfare | | |
| Minor Thoroughfare | | |

Figure 2

# RECOMMENDED THOROUGHFARE PLAN

# LILLINGTON

HARNETT COUNTY
NORTH CAROLINA

PREPARED BY THE

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS – GIS UNIT

IN COOPERATION WITH THE

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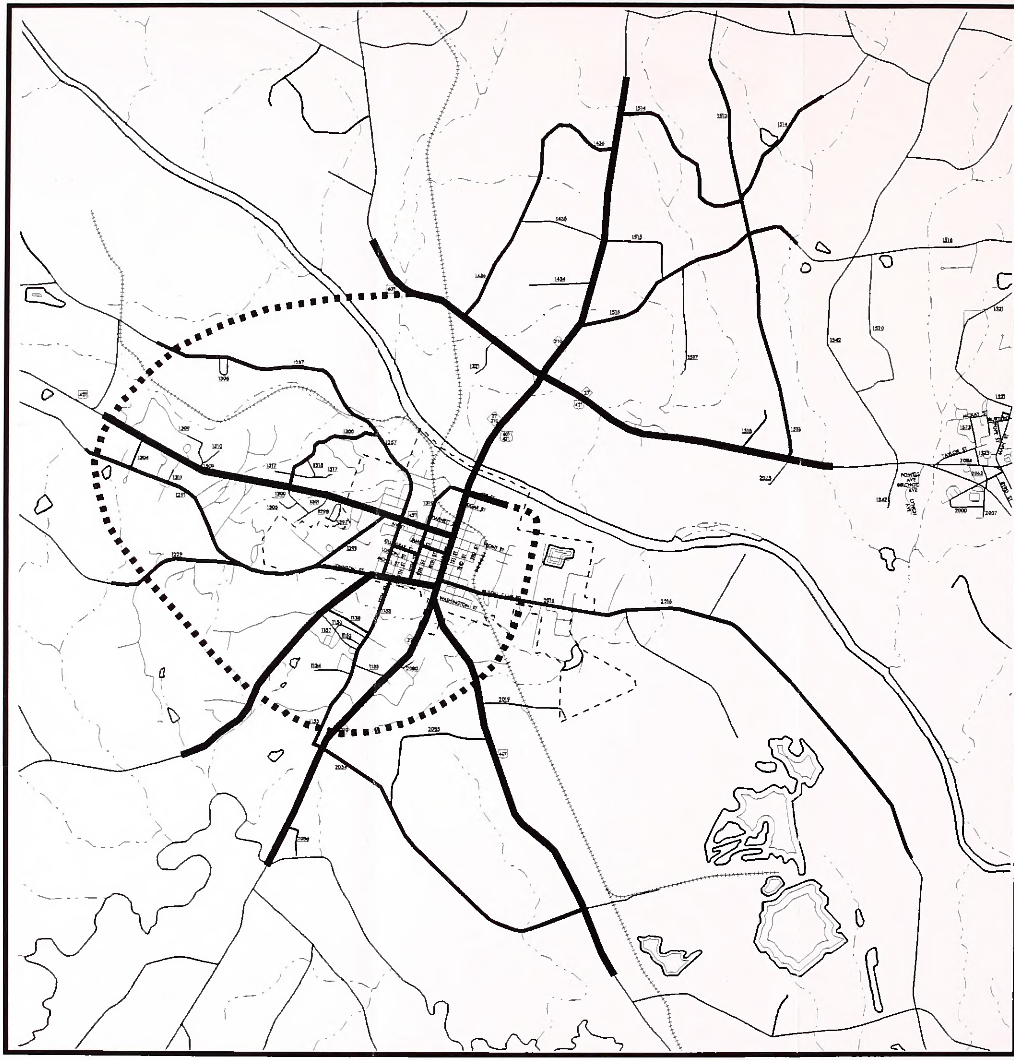
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 2 4 6 8
miles

0 1 2 3
kilometers



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SCALES

0 2 4 6 8
miles

0 1 2 3
kilometers

## Chapter 1

## INTRODUCTION

[1]The town of Lillington, the Harnett County Seat, dates back to 1861. The County Commissioners purchased 100 acres near the Cape Fear River, and the town was given its current name in honor of Alexander Lillington, a Cape Fear patriot. In 1867, the first courthouse was built, establishing the county seat. A legislative act established corporate limits for Lillington in February of 1872.

A small school was created in 1870. The first brick school building was erected in 1914. Twenty-two schools exist in Harnett County (17 are elementary schools).

The Cape Fear River, which served as a major source for irrigation and a conduit for exporting farm goods, now is a recreational haven and the source for much of the area's water needs. The river offers opportunities for fishing and boating, and serves as a focal point for the state's 2800-acre Raven Rock Park for picnicking, camping and nature hikes.[2]

This thoroughfare plan study takes into account the concerns of the Town of Lillington in addressing the patterns of future growth, the primary concern of the Town officials being traffic traveling through town. Thoroughfare plans are created to insure transportation system efficiency development through a cohesive, coordinated system of roads and highways. This report also documents the basic thoroughfare planning principles and procedures used in developing these recommendations. Chapter 1 provides an introduction to the study. Chapters 2 and 3 discusses traffic trends and other issues that affect transportation in the area, as well as the traffic analyses conducted. Detailed descriptions of the study recommendations are provided in Chapter 4. Finally, Chapter 5 discusses development of the traffic model used to determine deficiencies and recommendations.

Further information that will be useful to area planners is provided in the Appendices. The complete Thoroughfare Plan Street Tabulation and typical cross sections, including detailed recommendations, are contained in Appendix A. Appendices B and C address the thoroughfare planning principles and different methods by which the recommendations can be implemented. Environmental concerns considered in the development of the plan, and an overview of the involvement of the Town and the general public in the development of the plan are shown in Appendices D and E. Recommended definitions and design standards for subdivision ordinances are listed in Appendix F.

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[1] *1955 Harnett County Centennial Celebration Booklet*, and Harnett County Heritage, 1993.

The recommendations are based on general traffic, population, and land use data. Year 2025 average daily traffic projections were used to determine capacity deficiencies. Major and minor thoroughfares were located based on existing and anticipated land uses, field investigation, and topographic conditions. A geographic location of Lillington is shown in Figure 3 .

The recommended plan is based on anticipated growth of the urban area as currently perceived. Prior to construction of specific projects, a more detailed study will be required to reconsider development trends and to determine specific locations and design requirements.

# GEOGRAPHIC LOCATION MAP

## FOR

# LILLINGTON

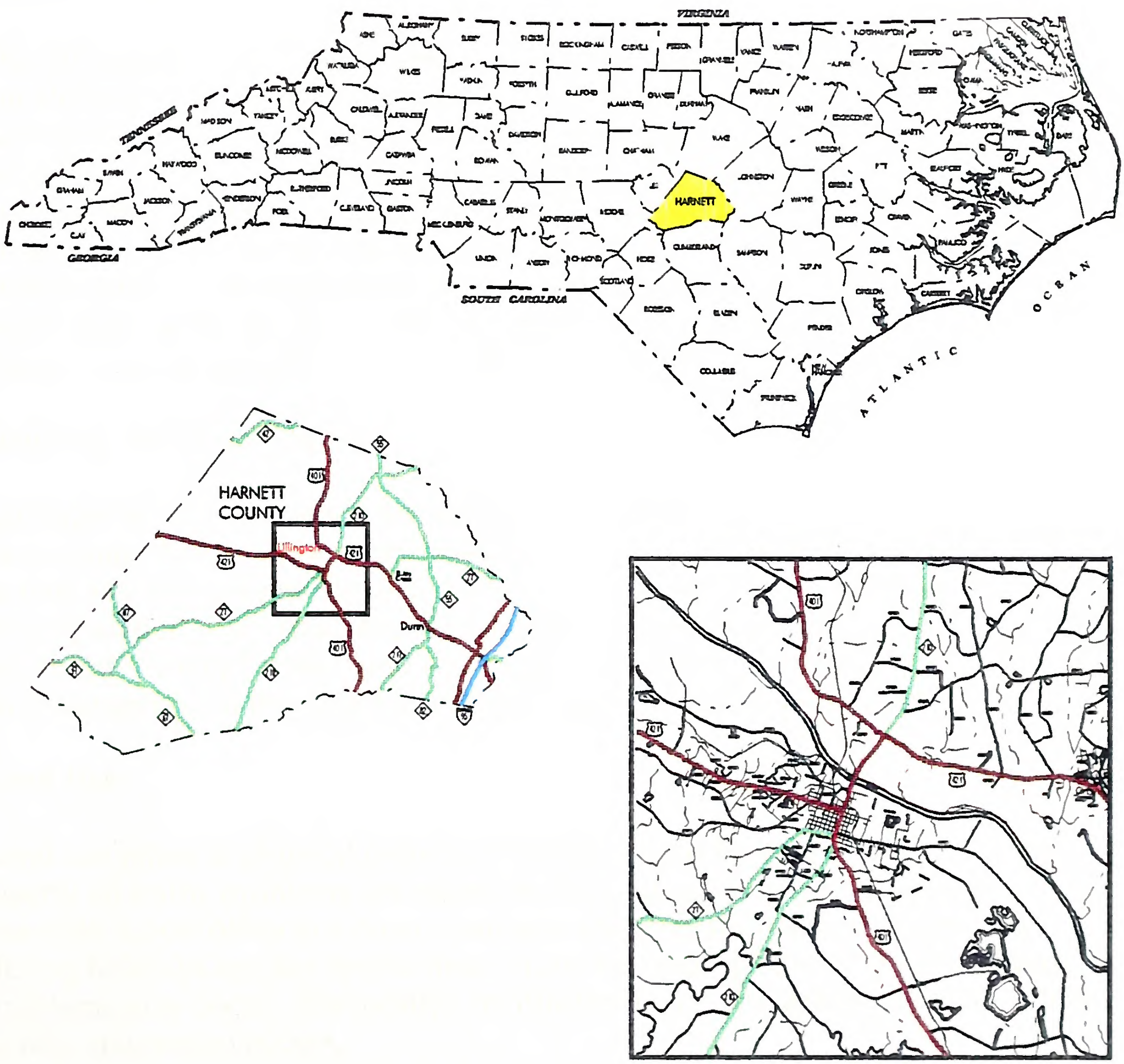


FIGURE 3

## Chapter 2

## TRENDS AND RELATED ISSUES

The objective of thoroughfare planning is to develop a transportation system which will enable people and goods to travel safely and economically. To find the needs of an area, population, land use, and traffic must be examined.

### Population Trends

The traffic volume on any roadway section is closely related to the size and distribution of the population served. By studying population trends, the future population and its distribution can be determined.

The Lillington study area has continued to increase its population over the years, but still remains as a rural community. Population trends and projections for Lillington and the planning boundary are shown as a graph in Figure 4. This table shows a large population increase expected in the planning area, which will bring an increase in the planning area traffic during the next thirty years. The projections were created by a trendline equation, information from the Office of State Planning, and discussions with the Town Council to determine the best population estimates. Table 1 shows the Lillington, surrounding townships, the planning area boundary, and Harnett County trends.

### Economy and Employment

An important factor needed for estimating the future traffic growth of an area is its economic base. The economic base determines the employment type and size, as well as commuter traffic patterns around the county. This in turn influences the population of an area. Business, town board management, and tourism have enhanced the employment and economic opportunities in the area. Refer to the land use section of this chapter for the businesses located in the planning area.

### Land Use

Land use refers to physical patterns of activities and functions within an area. Nearly all traffic problems are related to the land use in a specific area. For example, a post office in a downtown area might be the cause of congestion during holidays and tax-return time. However, during other days, few, if any, problems may occur. The location of different land uses determine when, where, & why congestion occurs.

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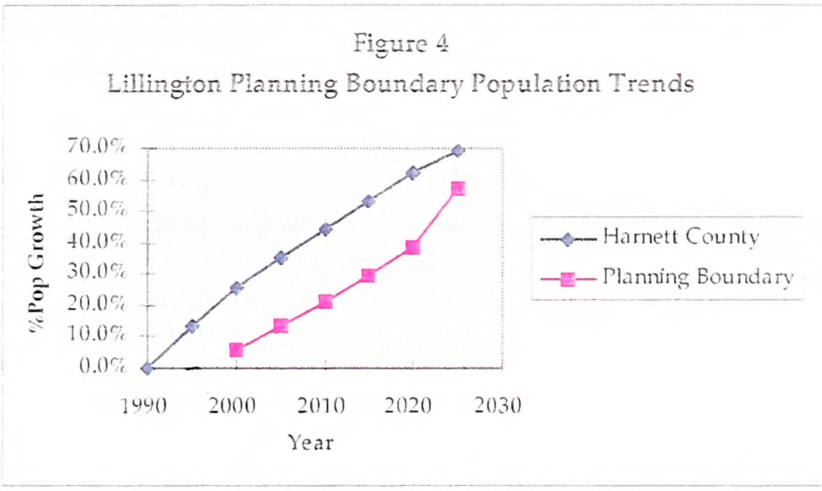


Figure 4
Lillington Planning Boundary Population Trends

**Table 1: Lillington Planning Boundary Population Trends**

| Year | Harnett County | Lillington Twp | Upper Little River Twp | Stewarts Creek Twp | Neills Creek Twp | Hectors CreekTwp | Anderson Creek Twp | Lillington | Planning Boundary |
|---|---|---|---|---|---|---|---|---|---|
| 1960 | 48,250 | 3,050 | 4,400 | 2,700 | 3,400 | 1,800 | 2,250 | 1,250 | ----- |
| 1970 | 49,700 | 3,650 | 4,050 | 2,400 | 4,100 | 1,600 | 3,100 | 1,200 | ----- |
| 1980 | 59,600 | 4,100 | 4,650 | 2,900 | 4,500 | 1,750 | 6,950 | 1,950 | ----- |
| 1990 | 67,850 | 4,000 | 5,550 | 3,050 | 4,700 | 2,000 | 9,450 | 2,050 | ----- |
| 1995 | 77,000 | ----- | ----- | ----- | ----- | ----- | ----- | 2,550 | |
| 1996 | 79,500 | ----- | ----- | ----- | ----- | ----- | ----- | 2,764 | 4,550 |
| 1997 | 81,358 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 4,650 |
| 2000 | 86,866 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 4,800 |
| 2005 | 94,664 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 5,150 |
| 2010 | 102,688 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 5,500 |
| 2015 | 110,620 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 5,900 |
| 2020 | 110,192 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 6,300 |
| 2025 | 118,150 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 7,150 |

Note: Information was obtained from the Office of State Planning and the US Census.

For use in transportation planning, land uses are grouped into four categories:

(1) Residential---all land for housing people (excluding hotels & motels);

(2) Commercial---all land devoted to retail trade including consumer & business services and offices;

(3) Industrial---all land devoted to manufacturing, storage, warehousing, and transportation of products;

(4) Public---all land devoted to social, religious, educational, cultural, recreational, and political activities.

The area houses four banking institutions, two weekly newspapers, a radio station, and fourteen industries, including Norwood Brick Co., Lillington Roller

plants of Becker Sand & Gravel Co., Titan Mobile Home Builders and Champion Mobile Home Builders add to the town's economic base.[2] Thirty-six churches & places of worship, along with three major newspapers, are received in the area. The Lillington planning area is predominantly a residential community.

Proposed land use for an area is based on its current land use. Determining where expected growth is to occur within the planning area facilitates the location of proposed thoroughfares. Areas of anticipated development and growth for the Lillington planning boundary are[3]:

> <u>Residential</u>: A large amount of Lillington residential land development is located at all corners of the planning boundary.
> <u>Commercial/Retail</u>: All new commercial development is expected to exist within the center of the planning boundary.
> <u>Industrial</u>: Any industrial development is expected to center around the northwestern and southeastern corners of the planning boundary.
> <u>Public</u>: No significant public land use growth expected within the planning boundary.

The Lillington planning area has a large potential for growth, due to its proximity to the Raleigh and Fayetteville urban areas. As a result, the southwestern and northern portions of the planning area are expected to experience the largest population growths.

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[2] "Lillington", Map from Lillington Chamber of Commerce, 1994.
[3] Information from Town Agencies and Harnett County, 1996.

## Chapter 3

## TRAVEL DEFICIENCY ANALYSIS OF EXISTING SYSTEM

This chapter presents an analysis of the existing street system. Emphasis is placed on detecting the deficiencies and understanding their cause. Capacity deficiencies may result from inadequate pavement width or intersection controls. System deficiencies may result from missing links or congestion.

### Travel Demand

The existing major street system satisfies the travel demand when characteristics of each thoroughfare (i.e., number of lanes) allow traffic to move safely and efficiently. The travel demand is generally reported as Annual Average Daily Traffic (AADT) counts. Traffic counts are taken regularly on State-maintained roads by the NCDOT.

A comparison of annual traffic growth rates from 1985 to 1995 at various count locations in the planning area shows average growth rates ranging from 0% to 5%. The largest growth was noticed on sections of NC 210 and Maime Upchurch Road. This is due to the increased travel between Angier and Lillington. Travel growth throughout the planning area is due to its proximity to the Raleigh and Fayetteville urban areas. Figure 6 shows the Annual Average Daily Traffic volumes from the design year (1995) to the future year (2025).

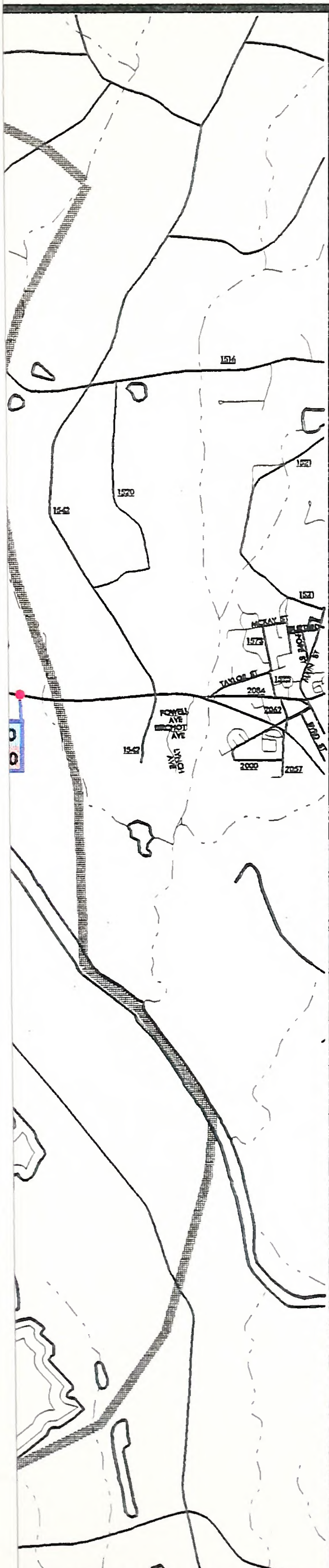
### Traffic Accidents

A traffic accident analysis is also completed as part of the thoroughfare planning process. The source of traffic accidents can be analyzed into three general categories: (1) the physical environment, (2) the driver, and (3) the physical attributes of the vehicle itself. The physical environment includes such things as weather and road conditions and obstructions. The driver influences the occurrence of traffic accidents through his mental alertness, distractions in the car, vehicle handling, and reaction time. The physical attributes of the vehicle include brake and tire condition and size of the vehicle. All traffic accidents can be attributed to one or more of these sources; however, the driver is often the primary source.

Accident data for January 1992 through October 1997 was studied for this report. Table 2 summarizes the accidents occurring during this time period within the planning boundary. Figure 7 shows locations with ten or more accidents over a five-and-a-half-year period. Table 3 summarizes these accidents along with the number and type of injuries involved.

**Table 2**
**Locations with 5 or More Accidents (Between 1/1/92 and 10/31/97)**

| | |
|---|---|
| **US 401/421/NC 27/210 (south of Cape Fear River): 52**<br>Ran-off-road: 1<br>Sideswipe: 1<br>Angle: 18<br>Rear-end: 11<br>Other: 8 (backup (2), parked veh. (5), overturn)<br>Right-turn-same-road: 3<br>Left-turn-different-road: 1<br>Left-turn-same-road: 9<br>Right-turn-different-road: 0 | **US 401/421/NC 27/210 (north of Cape Fear River): 40**<br>Ran-off-road: 0<br>Sideswipe: 3<br>Angle: 4<br>Rear-end: 19<br>Right-turn-same-road: 1<br>Other: 3 (overturn (2), other)<br>Left-turn-different-road: 2<br>Left-turn-same-road: 7<br>Right-turn-different-road: 1 |
| **US 401/NC 210/Washington Street (SR 2018): 38**<br>Ran-off-road: 4<br>Sideswipe: 1<br>Angle: 8<br>Rear-end: 12<br>Right-turn-same-road: 0<br>Other: 3 (fixed object (2), train)<br>Left-turn-different-road: 5<br>Left-turn-same-road: 5<br>Right-turn-different-road: 0 | **US 401/421/Duncan Street (SR 1319): 26**<br>Ran-off-road: 1<br>Sideswipe: 2<br>Angle: 9<br>Rear-end: 5<br>Right-turn-same-road: 1<br>Other: 2 (backup, fixed object)<br>Left-turn-different-road: 2<br>Left-turn-same-road: 4<br>Right-turn-different-road: 0 |
| **US 401/NC 27/James St: 23**<br>Ran-off-road: 0<br>Sideswipe: 0<br>Angle: 9<br>Rear-end: 4<br>Right-turn-same-road: 0<br>Other: 0<br>Left-turn-different-road: 3<br>Left-turn-same-road: 6<br>Right-turn-different-road: 1 | **US 421/South River Road (SR 1257): 15**<br>Ran-off-road: 1<br>Sideswipe: 1<br>Angle: 4<br>Rear-end: 1<br>Right-turn-same-road: 0<br>Other: 1 (fixed object)<br>Left-turn-different-road: 1<br>Left-turn-same-road: 6<br>Right-turn-different-road: 0 |
| **US 401/NC 27 (West Old St): 14**<br>Ran-off-road: 0<br>Sideswipe: 0<br>Angle: 3<br>Rear-end: 4<br>Right-turn-same-road: 0<br>Other: 0<br>Left-turn-different-road: 5<br>Left-turn-same-road: 1<br>Right-turn-different-road: 1 | **US 401/NC 27/McNeill St (SR 2016): 9**<br>Ran-off-road: 0<br>Sideswipe: 1<br>Angle: 2<br>Rear-end: 1<br>Right-turn-same-road: 0<br>Other: 0<br>Left-turn-different-road: 1<br>Left-turn-same-road: 4<br>Right-turn-different-road: 0 |
| Total = 217 | |




## LEGEND

1996 Annual Average Daily Traffic Count 00000
2025 Annual Average Daily Traffic Count 00000

Planning Area Boundary

# Figure 5

# ANNUAL AVERAGE DAILY TRAFFIC COUNTS

# LILLINGTON

HARNETT COUNTY
NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - GIS UNIT

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

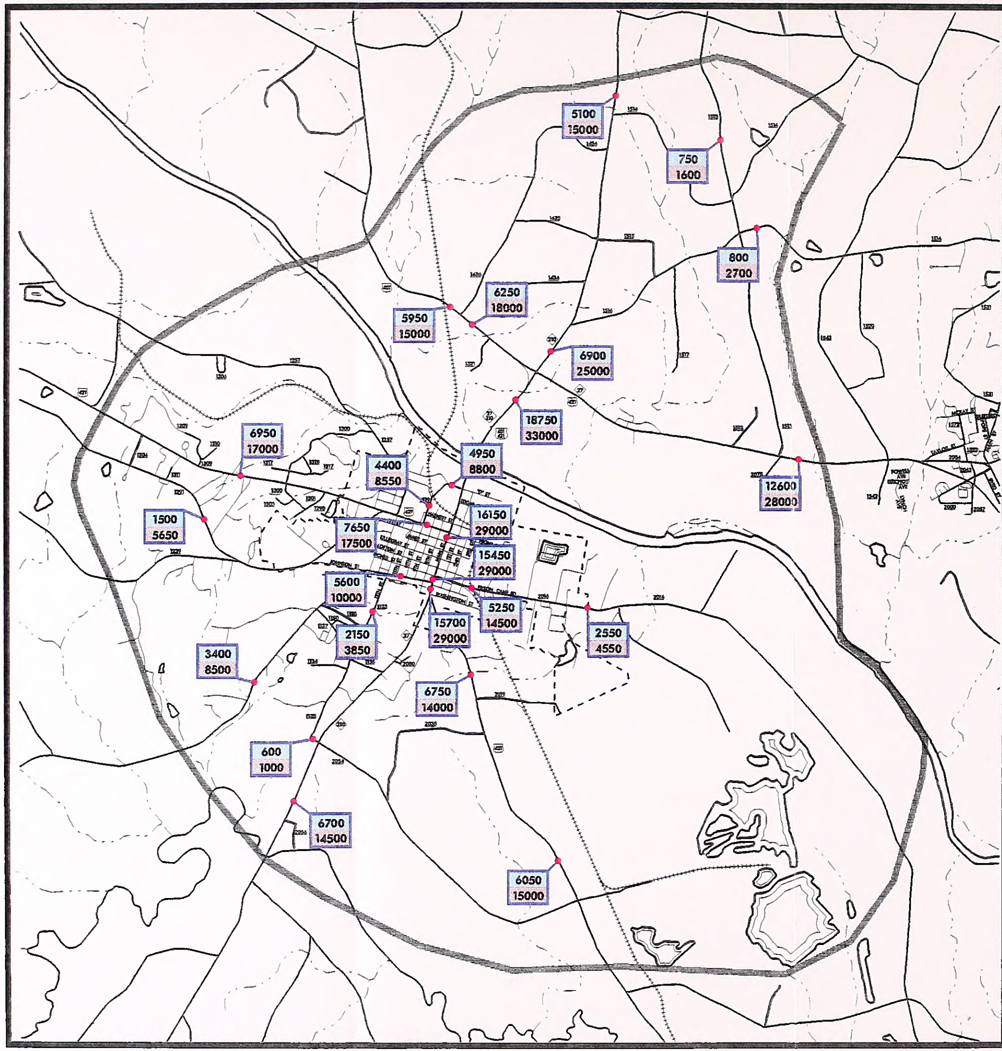
SCALES

0 2 4 6 8
miles

0 1 2 3
kilometers

## Table 2
## Locations with 5 or More Accidents (Between 1/1/92 and 10/31/97)

| | |
|---|---|
| **US 401/421/NC 27/210 (south of Cape Fear River): 52**<br>Ran-off-road: 1<br>Sideswipe: 1<br>Angle: 18<br>Rear-end: 11<br>Other: 8 (backup (2), parked veh. (5), overturn)<br>Right-turn-same-road: 3<br>Left-turn-different-road: 1<br>Left-turn-same-road: 9<br>Right-turn-different-road: 0 | **US 401/421/NC 27/210 (north of Cape Fear River): 40**<br>Ran-off-road: 0<br>Sideswipe: 3<br>Angle: 4<br>Rear-end: 19<br>Right-turn-same-road: 1<br>Other: 3 (overturn (2), other)<br>Left-turn-different-road: 2<br>Left-turn-same-road: 7<br>Right-turn-different-road: 1 |
| **US 401/NC 210/Washington Street (SR 2018): 38**<br>Ran-off-road: 4<br>Sideswipe: 1<br>Angle: 8<br>Rear-end: 12<br>Right-turn-same-road: 0<br>Other: 3 (fixed object (2), train)<br>Left-turn-different-road: 5<br>Left-turn-same-road: 5<br>Right-turn-different-road: 0 | **US 401/421/Duncan Street (SR 1319): 26**<br>Ran-off-road: 1<br>Sideswipe: 2<br>Angle: 9<br>Rear-end: 5<br>Right-turn-same-road: 1<br>Other: 2 (backup, fixed object)<br>Left-turn-different-road: 2<br>Left-turn-same-road: 4<br>Right-turn-different-road: 0 |
| **US 401/NC 27/James St: 23**<br>Ran-off-road: 0<br>Sideswipe: 0<br>Angle: 9<br>Rear-end: 4<br>Right-turn-same-road: 0<br>Other: 0<br>Left-turn-different-road: 3<br>Left-turn-same-road: 6<br>Right-turn-different-road: 1 | **US 421/South River Road (SR 1257): 15**<br>Ran-off-road: 1<br>Sideswipe: 1<br>Angle: 4<br>Rear-end: 1<br>Right-turn-same-road: 0<br>Other: 1 (fixed object)<br>Left-turn-different-road: 1<br>Left-turn-same-road: 6<br>Right-turn-different-road: 0 |
| **US 401/NC 27 (West Old St): 14**<br>Ran-off-road: 0<br>Sideswipe: 0<br>Angle: 3<br>Rear-end: 4<br>Right-turn-same-road: 0<br>Other: 0<br>Left-turn-different-road: 5<br>Left-turn-same-road: 1<br>Right-turn-different-road: 1 | **US 401/NC 27/McNeill St (SR 2016): 9**<br>Ran-off-road: 0<br>Sideswipe: 1<br>Angle: 2<br>Rear-end: 1<br>Right-turn-same-road: 0<br>Other: 0<br>Left-turn-different-road: 1<br>Left-turn-same-road: 4<br>Right-turn-different-road: 0 |
| Total = 217 | |




**LEGEND**

1996 Annual Average Daily Traffic Count 00000
2025 Annual Average Daily Traffic Count 00000

Planning Area Boundary

Figure 5

# ANNUAL AVERAGE DAILY TRAFFIC COUNTS

# LILLINGTON

HARNETT COUNTY
NORTH CAROLINA

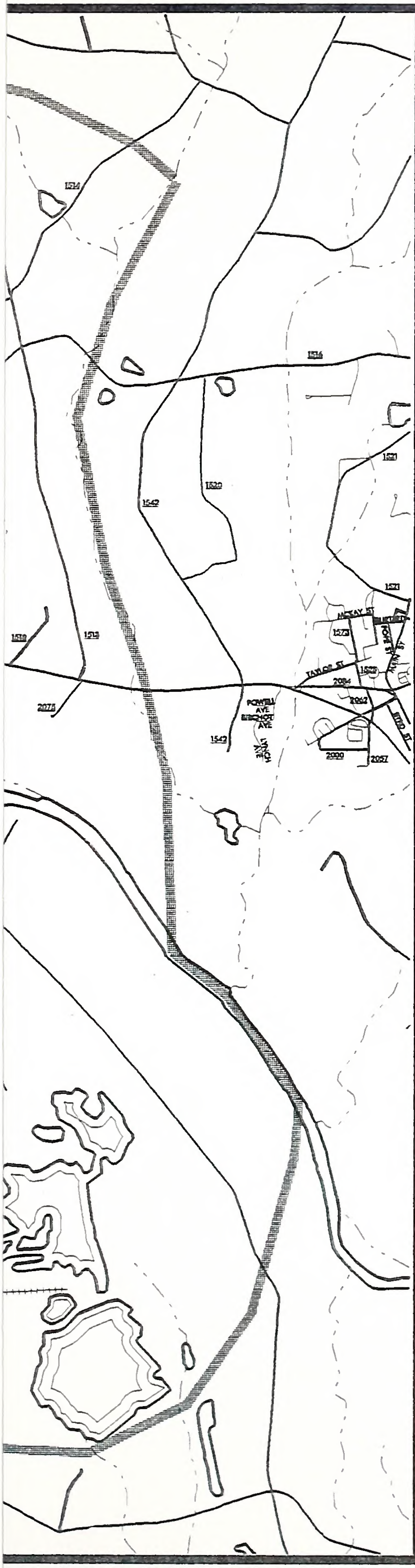
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - GIS UNIT

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 2 4 6 8
miles

0 1 2 3
kilometers




## LEGEND

Accident Location

Number of Accidents ##

Planning Area Boundary

**NOTE:**

Only accident locations with 5 or more accidents over a 5 1/2 year period are sited.

Figure 6

# ACCIDENT LOCATIONS

# LILLINGTON

HARNETT COUNTY
NORTH CAROLINA

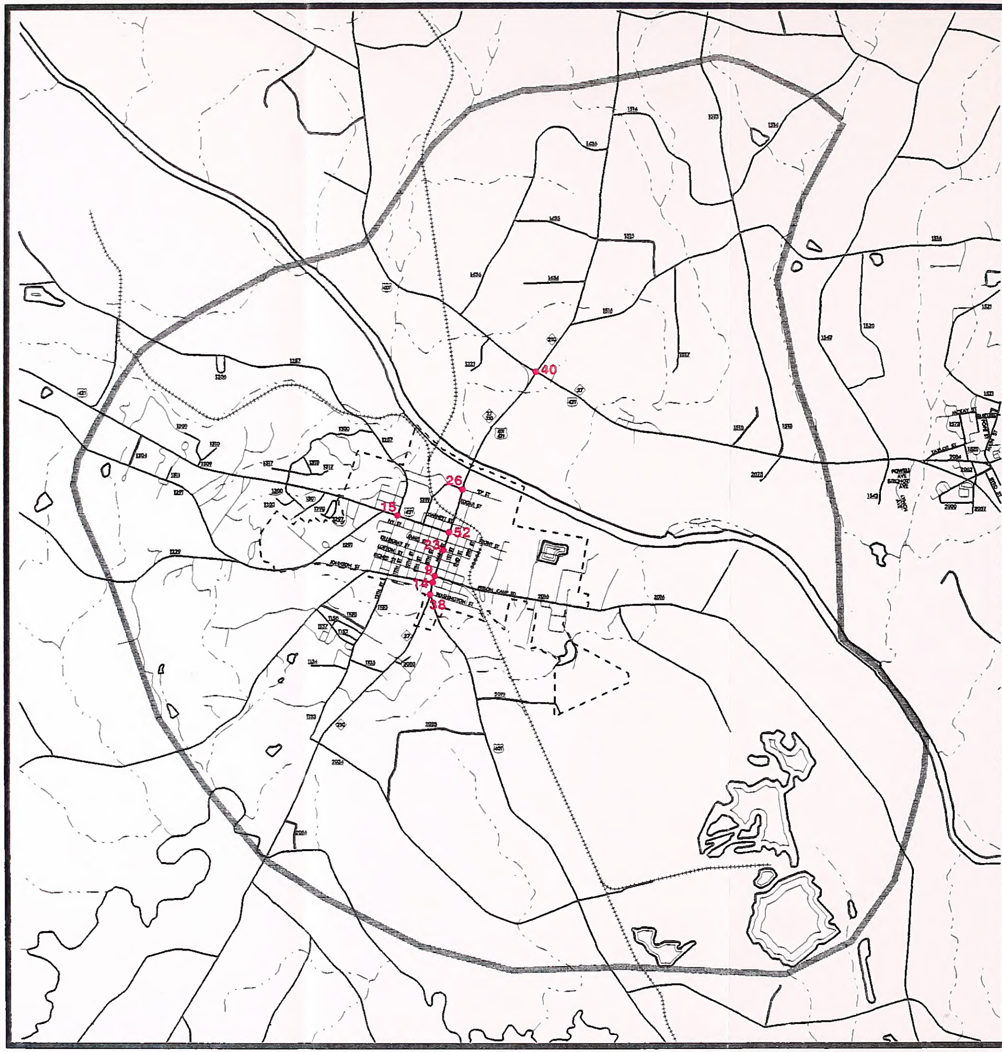
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - GIS UNIT

U.S.DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 2 4 6 8

0 1 2 3




## LEGEND

Accident Location •

Number of Accidents ##

Planning Area Boundary

**NOTE:**

Only accident locations with 5 or more accidents over a 5 1/2 year period are sited.

Figure 6

# ACCIDENT LOCATIONS

# LILLINGTON

HARNETT COUNTY
NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - GIS UNIT

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 2 4 6 8
miles

0 1 2 3
kilometers

Table 3
Locations with 5 or More Accidents over a 5.5-Year Period

| Location | Number of Accidents | Number of Injuries | Severity Code | | | |
|---|---|---|---|---|---|---|
| | | | F | A | B | C |
| US 401/421/NC 27/210 (in Lillington) | 52 | 22 | 0 | 0 | 3 | 19 |
| US 401/421/NC 27/210 (North of Cape Fear River) | 40 | 27 | 0 | 0 | 3 | 24 |
| US 401/NC 210/Wash. St | 38 | 31 | 0 | 5 | 6 | 21 |
| US 401/421/Duncan St | 29 | 28 | 0 | 3 | 5 | 20 |
| US 401/NC 27/James St | 23 | 8 | 0 | 0 | 0 | 8 |
| US 421/South River Road | 15 | 9 | 0 | 1 | 2 | 6 |
| US 401/NC 27 (West Old St) | 14 | 9 | 0 | 2 | 1 | 6 |
| US 401/NC 27/McNeill St | 9 | 6 | 0 | 0 | 2 | 4 |

Key to Severity Codes:

F: Fatality

A: Class "A" Injury (Incapacitating). The injury is obvious and severe enough to prevent carrying on normal activities for at least 24 hours; e.g., massive loss of blood or broken bone.

B: Class "B" Injury (Non-incapacitating). In this case, and injury other than a fatality or Class "A" injury is evident.

C: Class "C" Injury. No visible sign of injury, but complaint of pain or momentary loss of consciousness occurs.

**Traffic Model Development**

In order to develop an efficient Thoroughfare Plan for the Town of Lillington, a traffic model was developed and calibrated using the TRANPLAN computer program. This traffic model was designed to simulate the traffic patterns in Lillington based on the following information: base year traffic counts, socioeconomic data, trip generation characteristics of the study area, and future (design year) estimates of socioeconomic data. A calibrated traffic model is created from the base year information and is used to evaluate the effectiveness of alternatives in addressing identified problem areas for the base year. The design year information is applied to the calibrated traffic model to evaluate the effectiveness of solutions addressing problem areas for the design year.

A description of the model development process is shown in Appendix F.

**Capacity Analysis**

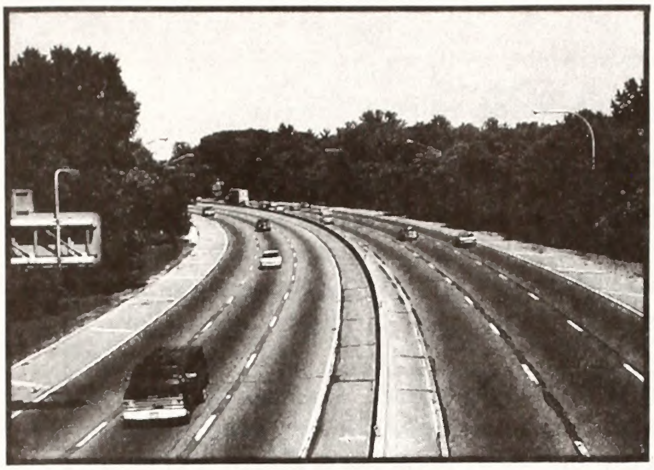
Capacity deficiencies are found by comparing the traffic volumes with the traffic mobility of the streets. The ability of traffic to move on a street freely, safely, and efficiently with a minimum delay is controlled principally by the spacing of signs, the number of traffic signals used, or parking.

A capacity analysis will determine the *level of service* being provided. Six levels of service identify the range of possible conditions. (See Table 4 and Figure 8 for more of an

Table 4: Level of Service

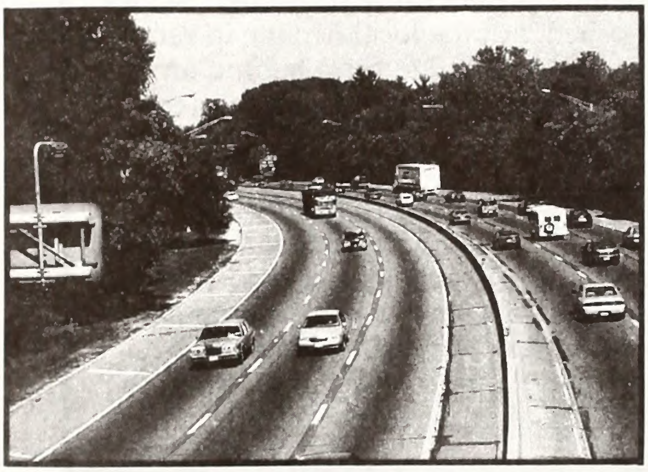
| | |
|---|---|
| **LOS A** | Describes primarily free flow conditions. The motorist experiences a high level of physical and psychological comfort. The effects of minor incidents of breakdown are easily absorbed. Even at the maximum density, the average spacing between vehicles is about 528 ft, or 26 car lengths. |
| **LOS B** | Represents reasonably free flow conditions. The ability to maneuver within the traffic stream is only slightly restricted. The lowest average spacing between vehicles is about 330 ft, or 18 car lengths. |
| **LOS C** | Provides for stable operations, but flows approach the range in which small increases will cause substantial deterioration in service. Freedom to maneuver is noticeably restricted. Minor incidents may still be absorbed, but the local decline in service will be great. Queues may be expected to form behind any significant blockage. Minimum average spacings are in the range of 220 ft, or 11 car lengths. |
| **LOS D** | Borders on unstable flow. Density begins to deteriorate somewhat more quickly with increasing flow. Small increases in flow can cause substantial deterioration in service. Freedom to maneuver is severely limited, and the driver experiences drastically reduced comfort levels. Minor incidents can be expected to create substantial queuing. At the limit, vehicles are spaced at about 165 ft, or nine car lengths. |
| **LOS E** | Operations in this level are volatile with little or no usable gaps in the traffic stream. Any disruption to the traffic stream can cause a wave of delay that propagates throughout the upstream traffic flow. This can produce a serious breakdown with extensive queuing. Maneuverability within the traffic stream is extremely limited, and driver tensions are high. The high delay values created by LOS F at signalized intersections indicate poor progression, long cycle lengths, and high v/c ratios (ratio of the demand flow rate to capacity for a traffic facility). |
| **LOS F** | Describes forced or breakdown flow. Such conditions generally exist within queues forming behind breakdown points. |

Source: 1994 Highway Capacity Manual

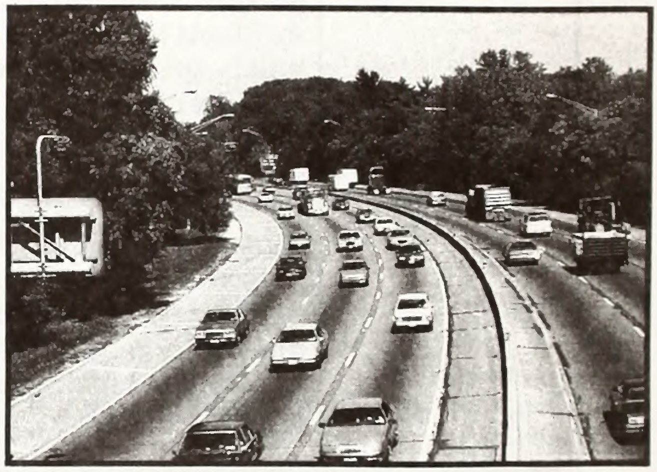


LOS A.

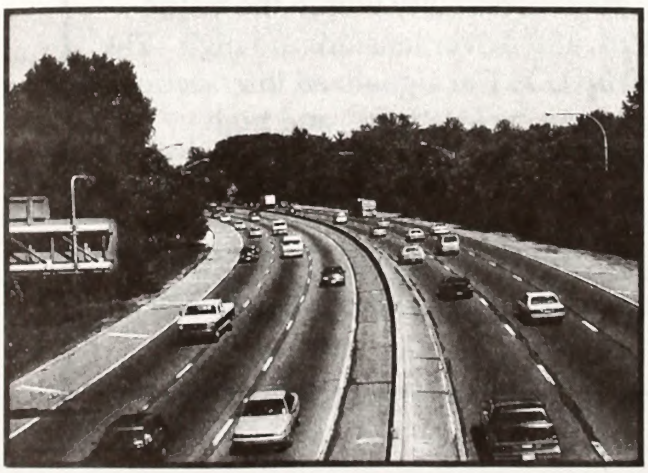
LOS D.



LOS B.



LOS E.



LOS C.

LOS F.

# FIGURE 7

## LEVELS OF SERVICE

explanation.) The definitions are general & conceptual in nature, but may be applied to urban arterial levels of service. The 1994 Highway Capacity Manual contains more detailed descriptions of the levels of service as defined for each facility type.

The recommended improvements and overall design of the Thoroughfare Plan were based on achieving a minimum of LOS D on existing and new facilities. LOS D is considered the "practical capacity" of a facility, or that at which the public begins to express dissatisfaction.

The primary routes serving Lillington are US 401, US 421, NC 27 and NC 210, as well as routes Prison Camp Road, Old US 421, and Thirteenth Street. Capacity problems in the Lillington area in the base year (1995) exist along US 401 and NC 210 in two locations: the US 401/421/NC 27/210 intersection north of the Cape Fear River and along Main Street from the railroad crossing (south of Duncan Street) to the US 401/NC 210/Washington Street intersection. The design year (2025) yields a much greater capacity problem. Capacity deficiencies emerge along US 401 from the western planning boundary to 0.2 mi west of the US 401/US 421/NC 27/210 intersection north of the Cape Fear River and from the Lillington southern city limits to the southeastern planning boundary.

US 421 is also challenged from Old US 421 to the western planning boundary. NC 210 has traffic reaching over capacity for almost all of its route throughout the planning boundary. Main Street also experiences congestion from the railroad south of Duncan Street to the US 401/NC 210/Washington Street intersection. The traffic along NC 27 from Shawtown Road to Fuller Road is approaching capacity in the future year.

## Chapter 4

## RECOMMENDATIONS

This chapter presents the thoroughfare plan recommendations. It is the goal of this study to recommend a plan for the transportation system that will serve the anticipated traffic and land development needs of the planning area over the next 30 years. The primary objective of this plan is to reduce traffic congestion and improve safety by eliminating both existing and anticipated deficiencies in the thoroughfare system. These recommendations are shown in Figure 1. The recommended thoroughfare plan is shown in Figure 2.

### Major Thoroughfares

**US 401** is a 2-lane facility traversing the Lillington planning boundary. TIP Project R-2609 will widen US 401 to a multi-lane facility from multi-lanes located north of Fayetteville to Fuquay-Varina. This project has been identified as a future need. A feasibility study has been completed for the TIP project without the allotted funding. No further improvements are recommended for US 401.

**US 421** is a four-lane facility starting from the east end of the boundary to Old US 421 in the town limits. At that point, the highway becomes a two-lane facility. In September 1995, this section of US 421 was resurfaced. Over-capacity conditions occur in the design year from Old US 421 to the western planning boundary. Because of the large amount of travel from US 421/NC 27 to US 421 North and US 401 (and along Main Street), a bypass is needed in the planning boundary. It is recommended to widen this section from two to four lanes.

**NC 27** is concurrent with US 401 and US 421 within the planning boundary to a point 0.05 mi south of McNeil Street/Prison Camp Road. At that point, the highway turns west and becomes a two-lane facility until the west planning boundary limits. NC 27 should be widened to 7.32 m (24 ft) from Main Street to the western planning boundary for safety reasons.

**NC 210** begins as a two-lane facility north of the town limits. Continuing south, it becomes concurrent with US 401, US 421, and NC 27. NC 210 continues southeast to the south planning boundary limits and the Fort Bragg Army/Pope Air Force Base Areas. The TIP Project R-2230 will upgrade NC 210 with multi-lane sections and two other lane improvements from Spring Lake to Lillington. Construction began in 1995. The proposed US 421 bypass will also alleviate congestion along this route. No further improvements are recommended for NC 210.

**Main Street** is the four-lane thoroughfare traversing the center of town. Routes US 401, US 421, NC 27, and NC 210 are signed concurrently along Main Street within the town limits. A bypass around the town or widening of the existing street would remedy capacity deficiencies on Main Street and in the Lillington downtown area.

**Neill's Creek Road (SR 1513)** extends north from US 421/NC 27 and continues to the planning boundary. The road serves residential and farm properties, and churches in the area. No capacity problems are expected along this route. Two high schools are located between NC 210 & Neill's Creek Road. They are located outside of the planning boundary, but will contribute significant traffic to the Lillington planning area.

**McNeil Street/Prison Camp Road (SR 2016)** extends east from Main Street as a four-lane facility to the Lillington east town limits. Between the town limits and the planning area boundary, the facility cross section has two lanes. Industrial and residential areas exist along the road. No capacity problems will exist on this route. The Nello L. Teer Sand Quarry is located approximately 4.6 miles east of the Lillington town limits along Prison Camp Road. This industry will increase the truck traffic on this route.

### Proposed Major Thoroughfares

**Proposed Loop Road:** This route connects US 401 North, US 421 North, Old US 421, McDougald Road, NC 27 West, Shawtown Road, NC 210 West, US 401 South, Prison Camp Road, and Main Street. It is recommended to be a four-lane divided facility. This route is expected to handle the travel through the planning area and to create another route over the Cape Fear River. The major movement of traffic coming from the Dunn/Buies Creek area (on US 421 South/NC 27 North) and headed towards Sanford by US 421 North will be served by this bypass.

### Minor Thoroughfares

The minor thoroughfares need no major improvements. Appendix A lists specific improvements needed on these routes.

There are no proposed minor thoroughfares for the planning area.

Many two-lane, state-maintained facilities in the area have lane widths less than 12 feet. Roads less than 22 feet shall be widened to 22 feet for safe and adequate operation. These facilities are also given in Appendix A .

# Appendix A

## Lillington Planning Area

## Typical Cross Sections, Thoroughfare Plan Street Tabulation, and Recommendations

## Typical Cross Sections

Cross section requirements for thoroughfares vary according to the desired capacity and level of service to be provided. Universal standards in the design of thoroughfares are not practical. Each street section must be individually analyzed and its cross section requirements determined on the basis of amount and type of projected traffic, existing capacity, desired LOS, and available right-of-way (ROW).

Typical cross sections recommended by the Statewide Planning Branch are shown in Figure 11. These cross sections are typical for facilities at new locations & where ROW constraints are not critical. For widening or urban projects with limited ROW, special cross sections should be developed that meet the needs of the project.

Recommended typical cross sections for thoroughfares were derived on the basis of projected traffic, existing capacities, desirable levels of service, and available ROW.

On all existing and proposed major thoroughfares delineated on the thoroughfare plan, adequate ROW should be protected or acquired for the ultimate cross sections. Ultimate desirable cross sections for each of the thoroughfares are listed here. Recommendations for "ultimate" cross sections are provided for:

1) thoroughfares requiring widening after the current planning period;
2) thoroughfares which are borderline adequate, where accelerated traffic growth could render them deficient; and
3) thoroughfares where an urban curb-and-gutter cross section may be locally desirable because of urban expansion or redevelopment.

Recommended design standards relating to maximum and minimum grades, minimum sight distances, maximum degree of curve and related superelevation, and other considerations for thoroughfares are given in Appendix D.

*A - Four Lanes Divided with Median, Freeway*
This cross section is typical for four-lane divided highways in rural areas which may have only partial or no control of access. The minimum median width for this cross section is 14 m (46 feet), but a wider median is desirable.

*B - Seven Lanes, Curb & Gutter*
This cross section is not recommended for new projects. When the conditions warrant six lanes, cross section "D" should be recommended. Cross section "B" should be used only in special situations such as widening from a five lane section when ROW is limited. Even in these situations, consideration should be given to converting the center turn lane to a median so that cross section "D" is the final cross section.

*C - Five Lanes, Curb & Gutter*
Typical for major thoroughfares, this cross section is desirable where frequent left turns are anticipated as a result of abutting development or frequent street intersections.

*D - Six Lanes Divided with Raised Median, Curb & Gutter*
*E - Four Lanes Divided with Raised Median, Curb & Gutter*
These cross sections are typically used on major thoroughfares where left turns and intersection streets are not as frequent. Left turns would be restricted to a few selected intersections. The 4.8 m (16 ft) median is the minimum recommended for an urban boulevard type cross section. In most instances, monolithic construction should be utilized due to greater cost effectiveness, ease and speed of placement, and reduced future maintenance requirements. In special cases, grassed or landscaped medians may be used in urban areas. However, these types of medians result in greatly increased maintenance costs and an increased danger to maintenance personnel. Non-monolithic medians should only be recommended when the above concerns are addressed.

*F - Four Lanes Divided, Boulevard, Grass Median*
Recommended for urban boulevards or parkways to enhance the urban environment and to improve the compatibility of major thoroughfares with residential areas. A minimum median width of 7.3 m (24 ft) is recommended with 9.1 m (30 ft) being desirable.

*G - Four Lanes, Curb & Gutter*
This cross section is recommended for major thoroughfares where projected travel indicates a need for four travel lanes but traffic is not excessively high, left turning movements are light, and ROW is restricted. An additional left turn lane would probably be required at major intersections. This cross section should be used only if the above criteria is met. If ROW is not restricted, future strip development could take place and the inner lanes could become de facto left turn lanes.

*H - Three Lanes, Curb & Gutter*
In urban environments, thoroughfares which are proposed to function as one-way traffic carriers would typically require this cross section.

*I - Two Lanes, Curb & Gutter with Parking on Both Sides*
*J - Two Lanes, Curb & Gutter with Parking on One Side*
Cross sections "I" and "J" are usually recommended for urban minor thoroughfares since these facilities usually serve both land service and traffic service functions. Cross section "I" would be used on those minor thoroughfares where parking on both sides is needed as a result of more intense development.

*K - Two Lanes, Paved Shoulder*
This cross section is used in rural areas or for staged construction of a wider multi-lane cross section. On some thoroughfares, projected traffic volumes may indicate that two travel lanes will adequately serve travel for a considerable period of time. For areas that are growing and future widening will be necessary, the full ROW of 30 m (100 ft) should be required. In some instances, local ordinances may not allow the full 30 m. In those cases, 21 m (70 ft) should be preserved with the understanding that the full 30 m will be reserved by use of building setbacks and future street line ordinances.

*L - Six Lanes Divided with Grass Median, Freeway*
Cross section "L" is typical for controlled access freeways. The 14 m (46 ft) grassed median is the minimum desirable median width, but there could be some variation from this depending upon design considerations. Right-of-way requirements would typically vary upward from 70 m (228 ft) depending upon cut and fill requirements.

*M - Eight Lanes Divided with Raised Median, Curb & Gutter*
Also used for controlled access freeways, this cross section may be recommended for freeways going through major urban areas or for routes projected to carry very high volumes of traffic.

*N - Five Lanes, Curb & Gutter, Widened Curb Lanes*
*O - Two Lanes, Shoulder Section*
*P - Four Lanes Divided with Raised Median, Curb & Gutter, Widened Curb Lanes*
If there is sufficient bicycle travel along the thoroughfare to justify a bicycle lane or bikeway, additional right-of-way may be required to contain the bicycle facilities. The North Carolina Bicycle Facilities Planning and Design Guidelines should be consulted for design standards for bicycle facilities.

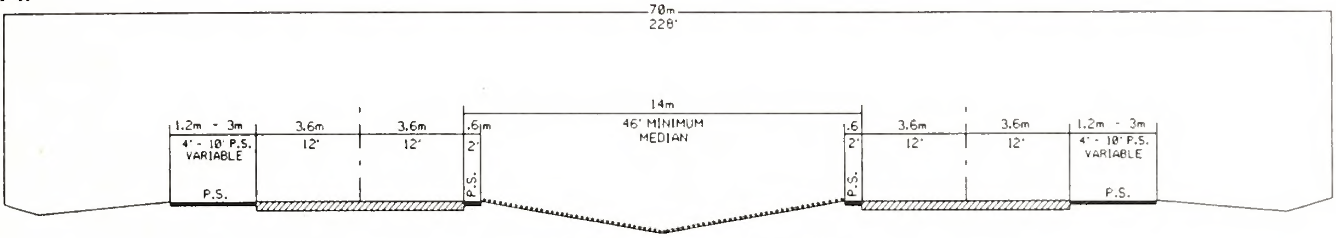
*Other General Information*
The urban curb & gutter cross sections illustrate the sidewalk adjacent to the curb with a buffer or utility strip between the sidewalk and the minimum ROW line. This permits adequate setback for utility poles. If the sidewalk is moved farther away from the street to provide additional separation for pedestrians or for aesthetic reasons, additional right-of-way must be provided to insure adequate setback for utility poles.

The rights-of-way shown for the typical cross sections are the minimum required to contain the street, sidewalks, utilities, and drainage facilities. Additional cut and fill may require additional ROW or construction easements. Obtaining construction easements is becoming the more common practice for urban thoroughfare construction.

# FIGURE 8

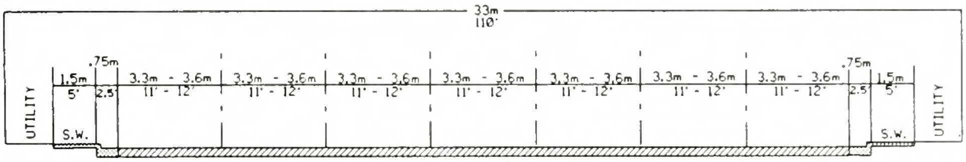
# TYPICAL THOROUGHFARE CROSS SECTIONS

A.



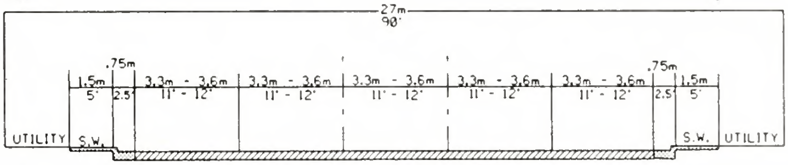

FOUR LANES DIVIDED WITH MEDIAN - FREEWAY

B.



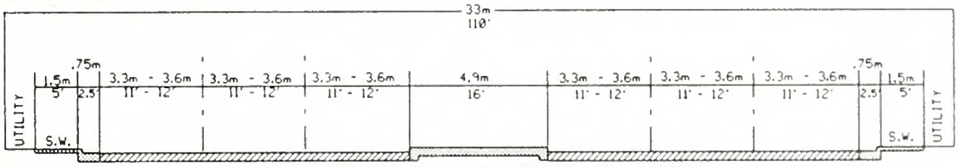

SEVEN LANES - CURB & GUTTER

C.




FIVE LANES - CURB & GUTTER

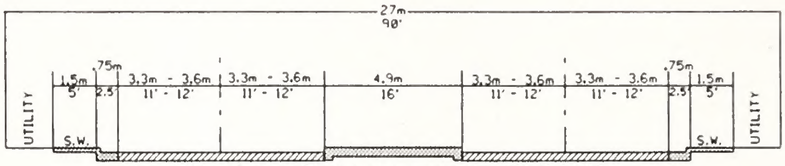
D.




SIX LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

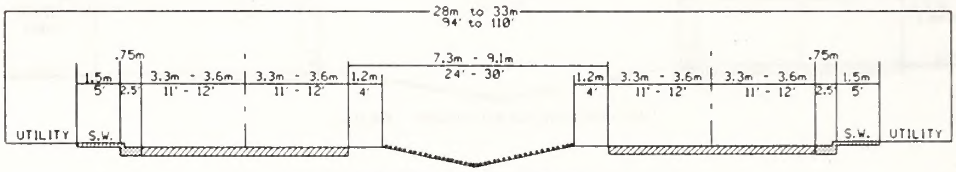
# TYPICAL THOROUGHFARE CROSS SECTIONS

E.



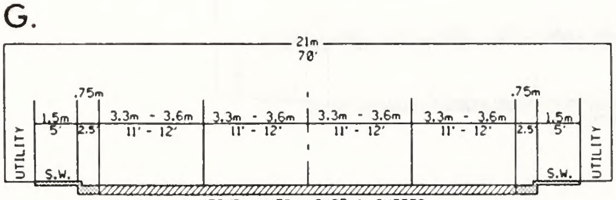

FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

F.



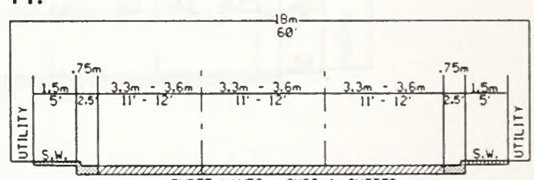

FOUR LANES DIVIDED - BOULEVARD
GRASS MEDIAN

G.



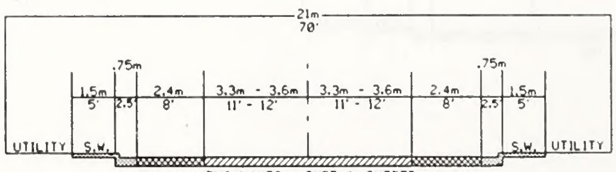

FOUR LANES - CURB & GUTTER

H.



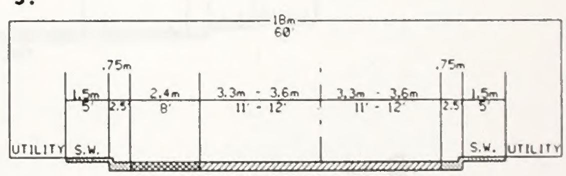

THREE LANES - CURB & GUTTER

I.



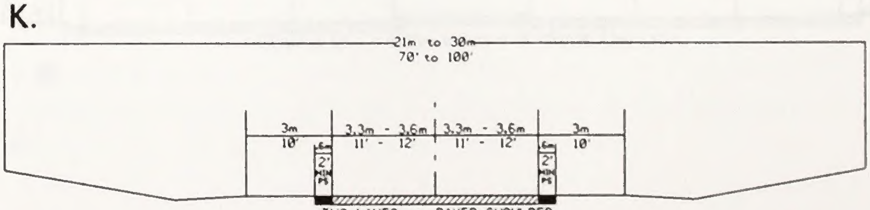

TWO LANES - CURB & GUTTER
PARKING ON EACH SIDE

J.




TWO LANES - CURB & GUTTER
PARKING ON ONE SIDE

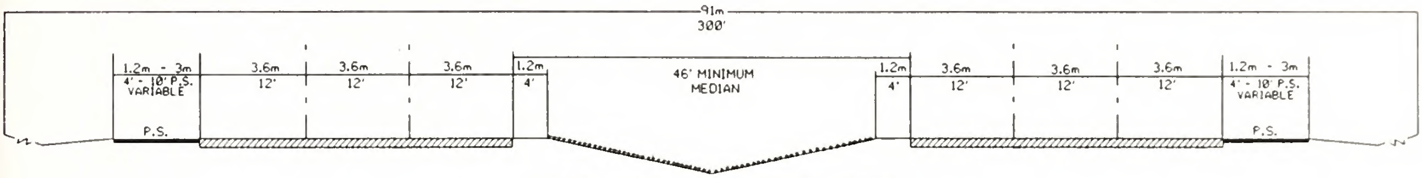
K.




TWO LANES - PAVED SHOULDER

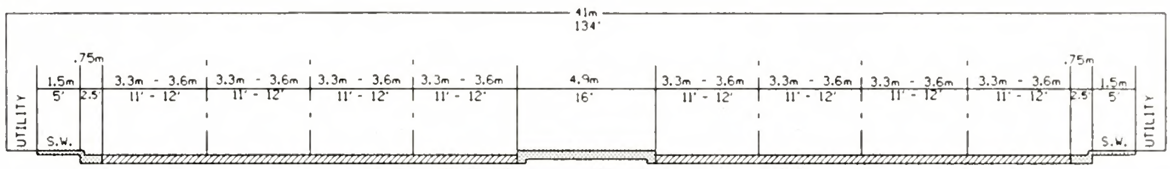
# TYPICAL THOROUGHFARE CROSS SECTIONS

L.




SIX LANES DIVIDED WITH GRASS MEDIAN - FREEWAY

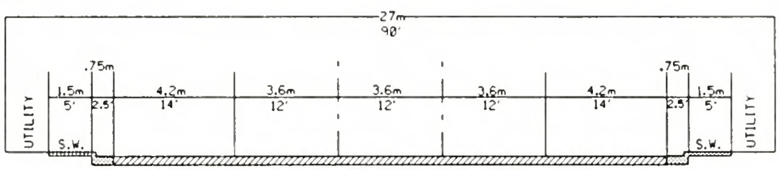
M.




EIGHT LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

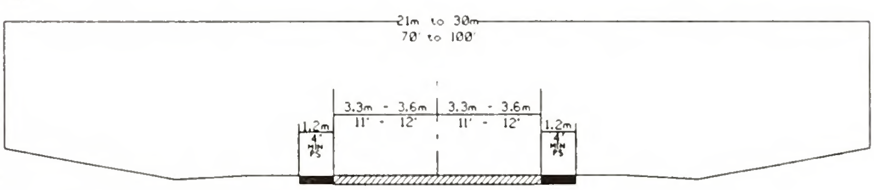
## TYPICAL THOROUGHFARE CROSS SECTIONS FOR ACCOMMODATING BICYCLES

N.



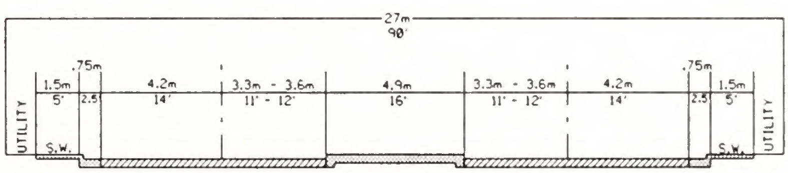

FIVE-LANE ROADWAY WITH CURB & GUTTER,
STANDARD INSIDE LANES & WIDENED CURB LANES

O.




TWO LANES - SHOULDER SECTION

P.




FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER,
STANDARD INSIDE LANES & WIDENED CURB LANES

## Thoroughfare Plan Street Tabulation and Recommendations

Table 13 shows a detailed tabulation of all roads identified as elements of the Lillington Thoroughfare Plan. It also includes a description of each road section, as well as the length, cross-section, and right-of-way for each section. Also included are existing and projected average summer weekday traffic volumes, roadway capacity, and the recommended ultimate lane configuration.

The following index of abbreviations may be helpful in interpreting Table 13:

- ADQ - Adequate
- AADT - Annual Average Daily Traffic
- int., ints. - intersection
- km - kilometers
- LL - Lillington
- m - meters
- mi - miles
- N--, S--, E--, W-- - North, South, East, West
- N/A - Not Available
- RDWY - Roadway Width
- ROW - Right of Way Width
- SR - Secondary Road
- thfare - thoroughfare
- UNK - Unknown
- vpd - Vehicles per Day

**Table 5**
**Lillington Thoroughfare Plan Chart**

| Facility and Section | | Existing Cross Section (1996) | | | | | | Future Cross Section (2025) | | | 2025 Recommended Cross Section | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Distance | Roadway | | ROW | Capacity | ADT | Capacity | ADT | ADT w/TIP Projs | | |
| from | to | (km) | (m) | Lanes | (m) | (vpd) | (vpd) | (vpd) | (vpd) | (vpd) | Cross Section | ROW (m) |
| US 401 | | | | | | | | | | | | |
| 0.16 km W of Bridge | Matthews Road | 1.29 | 7 | 2 | 30 | 13000 | 5950 | 42000 | 15000 | 15000 | ADQ | ADQ |
| Matthews Road | 0.31 km W of US 421/NC 27 | 0.81 | 7 | 2 | 30 | 13000 | 6250 | 42000 | 18000 | 18000 | ADQ | ADQ |
| 0.31 km W of US 421/NC 27 | US 421/NC27 | 0.31 | 20 | 4 | 30 | 42000 | 7350 | 42000 | 13100 | 24350 | ADQ | ADQ |
| US 421/NC27 | 0.32 km S of US 421/NC27 | 0.32 | 17 | 4 | 46 | 42000 | 18750 | 42000 | 33000 | 34000 | ADQ | ADQ |
| 0.32 km S of US 421/NC27 | NCL LL (Bridge) | 1.29 | 21 | 4 | 30 | 45000 | 18750 | 45000 | 44200 | 33000 | ADQ | ADQ |
| NCL LL | RR tracks | 0.64 | 21 | 4 | 30 | 39000 | 19350 | 39000 | 45600 | 33000 | ADQ | ADQ |
| RR tracks | NC 27 | 0.93 | 21 | 4 | 30 | 25000 | 16150 | 32500 | 29000 | 27000 | ADQ | ADQ |
| NC 27 | NC 210 | 0.08 | 11 | 3 | 30 | 23000 | 15700 | 32500 | 29000 | 29000 | ADQ | ADQ |
| NC 210 | 0.16 km S of NC 210 | 0.16 | 15 | 4 | 30 | 23000 | 8350 | 37000 | 22650 | 17250 | ADQ | ADQ |
| 0.16 km S of NC 210 | 0.24 km S of NC 210 | 0.08 | 11 | 3 | 30 | 23000 | 8350 | 42000 | 22650 | 17250 | ADQ | ADQ |
| 0.24 km S of NC 210 | SCL LL | 0.24 | 9 | 2 | 30 | 14000 | 8350 | 42000 | 22650 | 17250 | ADQ | ADQ |
| SCL LL | 0.81 km S of Joel Johnson Road/Becker Road | 5.69 | 9 | 2 | 30 | 13000 | 6400 | 42000 | 14000 | 14000 | ADQ | ADQ |
| US 421 | | | | | | | | | | | | |
| Culvert to | US 401/NC 27 | 3.94 | 20 | 4 | 46 | 42000 | 12600 | 42000 | 28000 | 28000 | ADQ | ADQ |
| [Concurrent with US 401] | [Concurrent to Front Street] | 2.49 | ------ | ------ | 30 | ------- | ----- | ------- | ----- | ----- | ------- | ------- |
| Main Street/Front Street | 0.08 km W of Main Street/Front Street | 0.08 | 18 | 4 | 24 | 27500 | 7650 | 32500 | 17500 | 17950 | ADQ | ADQ |
| 0.08 km W of Main Street/Front Street | South River Road | 0.72 | 18 | 4 | 24 | 28000 | 12700 | 28000 | 22600 | 21000 | ADQ | ADQ |
| South River Road | Old US 421 | 0.16 | 15 | 4 | 24 | 26000 | ----- | 26000 | 19650 | 19650 | ADQ[4] | ADQ[4] |
| Old US 421 | 0.16 km E of WCL of LL | 0.24 | 9 | 2 | 18 | 12500 | ----- | 12500 | 21000 | 21000 | ADQ[4] | ADQ[4] |
| 0.16 km E of WCL of LL | WCL of LL | 0.16 | 9 | 2 | 46 | 13000 | ----- | 13000 | 21000 | 21000 | ADQ[4] | ADQ[4] |
| WCL of LL | Oak Street | 0.80 | 9 | 2 | 46 | 12000 | ----- | 12000 | 20000 | 20000 | ADQ[4] | ADQ[4] |
| Oak Street | 3.12 km of W WCL of LL | 3.04 | 9 | 2 | 46 | 13000 | 6950 | 13000 | 17000 | 17000 | F | 37 |
| NC 27 | | | | | | | | | | | | |
| [Concurrent with US 421] | [Concurrent with US 401] | 3.94 | 20 | 4 | 46 | ----- | ----- | ----- | ----- | ----- | ADQ | ADQ |
| [Concurrent with US 401] | [Concurrent to 0.08 km S Prison Camp Road] | 0.69 | ------ | ------ | 30 | ----- | ----- | ----- | ----- | ----- | ADQ | ADQ |
| 0.08 km S of Prison Camp Road | Shawtown Road | 0.56 | 6 | 2 | 30 | 13000 | 5600 | 13000 | 10000 | 10000 | K | ADQ |
| Shawtown Road | WCL of LL | 0.18 | 6 | 2 | 30 | 13000 | 9050 | 13000 | 15000 | 13000 | K | ADQ |
| WCL of LL | 4.34 km W of WCL LL | 4.34 | 6 | 2 | 30 | 11000 | 3400 | 11000 | 8500 | 8300 | K | ADQ |
| NC 210 | | | | | | | | | | | | |
| 0.48 km N of Maime Upchurch Road | 0.1 km N of US 401 | 4.09 | 7 | 2 | 18 | 13000 | 5100 | 42000 | 15000 | 15000 | ADQ | ADQ |
| 0.1 km N of US 401 | US 401 | 0.10 | 14 | 4 | 18 | 10000 | 6900 | 35000 | 25000 | 25000 | ADQ | ADQ |
| [Concurrent with US 401] | [Concurrent to 0.16 km S of NC 27] | 3.27 | ------ | ------ | 30 | ----- | ----- | ----- | ----- | ----- | ADQ | ADQ |
| 0.16 km S of NC 27 | SCL of LL | 0.48 | 8 | 2 | 18 | 23000 | 9250 | 32500 | 22000 | 22000 | ADQ | ADQ |
| SCL of LL | Bridge | 3.19 | 7 | 2 | 18 | 13000 | 6700 | 42000 | 14500 | 14500 | ADQ | ADQ |
| Shawtown Road (SR 1133) | | | | | | | | | | | | |
| NC 27 | SCL of LL | 0.08 | 6 | 2 | 18 | 8500 | 2150 | 8500 | 3850 | 3850 | K | ADQ |
| SCL of LL | NC 210 | 2.26 | 6 | 2 | 18 | 9000 | 600 | 9000 | 1000 | 1000 | ADQ | ADQ |
| McDougald Road (SR 1229) | | | | | | | | | | | | |
| Old US 421 | 0.13 km W of Old US 421 | 0.13 | 6 | 2 | N/A | 9000 | 1500 | 9000 | 2650 | 2650 | K | 60 |
| 0.13 km W of Old US 421 | 1.45 km W of Old US 421 | 1.32 | 6 | 2 | N/A | 9000 | 900 | 9000 | 1600 | 1600 | K | 60 |
| N Thirteenth Street/South River Road (SR 1257) | | | | | | | | | | | | |
| NC 27 | US 421 | 0.76 | 7 | 2 | N/A | 12000 | 1850 | 12000 | 3300 | 3300 | ADQ | 60 |
| US 421 | NCL of LL | 0.68 | 6 | 2 | N/A | 10000 | 1100 | 10000 | 2550 | 2550 | ADQ | 60 |
| NCL of LL | 4.02 km W of NCL of LL | 4.02 | 6 | 2 | N/A | 11000 | 750 | 11000 | 1850 | 1850 | K | 60 |
| West Old Road (SR 1286) | | | | | | | | | | | | |
| NC 27 | Old US 421 | 0.72 | 6 | 2 | N/A | 12000 | 2000 | 12000 | 4650 | 4650 | ADQ | 60 |
| Old US 421 (SR 1291) | | | | | | | | | | | | |
| US 421 | West Old Road | 1.16 | 6 | 2 | N/A | 12000 | 2250 | 12000 | 4000 | 4000 | ADQ | 60 |
| West Old Road | 0.56 km W Old US 421/Willie Cameron Road | 3.70 | 6 | 2 | N/A | 11000 | 1500 | 11000 | 5650 | 5650 | K | 60 |

**Table 5**
**Lillington Thoroughfare Plan Chart**

| Facility and Section | | Existing Cross Section (1996) | | | | | | Future Cross Section (2025) | | | 2025 Recommended Cross Section | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Distance | Roadway | | ROW | Capacity | ADT | Capacity | ADT | ADT w/TIP Projs | | |
| from | to | (km) | (m) | Lanes | (m) | (vpd) | (vpd) | (vpd) | (vpd) | 2025 | Cross Section | ROW (m) |
| **Oak Street (SR 1300)** | | | | | | | | | | | | |
| South River Road | US 421 | 1.69 | 6 | 2 | N/A | 10000 | 150 | 10000 | 300 | 300 | ADQ | 60 |
| (no longer minor thoroughfare) US 421 | Dogwood Lane | 0.40 | 6 | 2 | N/A | 11000 | ----- | 11000 | ----- | ----- | ADQ | 60 |
| **Tenth Street/Duncan Street (SR 1319)** | | | | | | | | | | | | |
| NC 27 | US 421 | 0.64 | 6 | 2 | 18 | 11000 | 600 | 11000 | 1100 | 1100 | ADQ | ADQ |
| US 421 | 0.06 km N of US 421 | 0.06 | 13 | 2 | 18 | 13000 | 4400 | 13000 | 8550 | 7000 | ADQ | ADQ |
| 0.06 km N of US 421 | US 401 | 0.65 | 7 | 2 | 18 | 13000 | 4950 | 13000 | 8800 | 7000 | ADQ | ADQ |
| **Neill's Creek Road (SR 1513)** | | | | | | | | | | | | |
| 1.13 km N of Maime Upchurch Road | 0.06 km N of US 421 | 4.60 | 6 | 2 | N/A | 9000 | 900 | 9000 | 1600 | 1600 | ADQ | 60 |
| 0.06 km N of US 421 | US 421/NC 27 | 0.06 | 7 | 2 | N/A | 13000 | ----- | 13000 | ----- | ----- | ADQ | 60 |
| **Maime Upchurch Rd (SR 1514)** | | | | | | | | | | | | |
| NC 210 | Neill's Creek Road | 2.25 | 6 | 2 | 18 | 11000 | 150 | 11000 | 200 | 200 | ADQ | ADQ |
| Neill's Creek Road | Culvert | 0.80 | 6 | 2 | N/A | 10000 | 300 | 10000 | 850 | 850 | ADQ | 60 |
| **Old Coats Road/Sheriff Johnson Road (SR 1516)** | | | | | | | | | | | | |
| NC 210 | Bridge | 3.22 | 6 | 2 | N/A | 11000 | 800 | 11000 | 2700 | 2700 | K | 60 |
| **McNeil Street/Prison Camp Road (SR 2016)** | | | | | | | | | | | | |
| US 401 | 1.29 km E of RR tracks | 1.77 | 15 | 4 | N/A | 34000 | 5250 | 34000 | 14500 | 14500 | ADQ | 60 |
| 1.29 km E of RR tracks | ECL of LL | 0.32 | 6 | 2 | N/A | 10500 | 2550 | 10500 | 4550 | 4550 | K | 60 |
| ECL of LL | 4.83 km E of ECL of LL | 4.83 | 6 | 2 | N/A | 11000 | 1850 | 11000 | 3300 | 3300 | K | 60 |
| **Washington Street (SR 2018-not thoroughfare)** | | | | | | | | | | | | |
| US 401 | Existing Washington Street | ****PROPOSED**** | | | | | | | | | K | 60 |
| Existing Washington Street | Dead End | 0.80 | 7 | 2 | N/A | 12000 | ----- | 12000 | ----- | ----- | ADQ | 60 |
| **Joel Johnson Road (SR 2034)** | | | | | | | | | | | | |
| NC 210 | 0.81 km W of US 421 | 4.51 | 6 | 2 | N/A | 9000 | ----- | 9000 | ----- | ----- | ADQ | 60 |
| 0.81 km W of US 421 | US 421 | 0.80 | 6 | 2 | N/A | 11000 | 700 | 11000 | 1250 | 1250 | ADQ | 60 |
| **Stock Yard Road (SR 2035)** | | | | | | | | | | | | |
| SR 2034 | 0.8 km N of Joel Johnson Road | 0.80 | 8 | 2 | N/A | 9000 | 250 | 9000 | 700 | 700 | ADQ | 60 |
| 0.8 km N of Joel Johnson Road | US 401 | 1.29 | 7 | 2 | N/A | 8000 | ----- | 8000 | ----- | ----- | ADQ | 60 |
| **Killegray Street** | | | | | | | | | | | | |
| Tenth Street | Thirteenth Street | 0.35 | 6 | 2 | N/A | 11000 | 250 | 11000 | 450 | 450 | ADQ | 60 |
| **James Street** | | | | | | | | | | | | |
| Main Street | Tenth Street | 0.34 | 9 | 2 | N/A | 15000 | ----- | 15000 | ----- | ----- | ADQ | 60 |
| **US 421 Bypass** | | | | | | | | | | | | |
| US 401 | US 421 | 8.53 | ****PROPOSED**** | | | | | 50000 | 8650 | 8650 | F | 200 |
| US 421 | Old US 421 | 1.53 | ****PROPOSED**** | | | | | 30000 | 6800 | 6800 | F | 200 |
| Old US 421 | McDougald Road | 3.16 | ****PROPOSED**** | | | | | 50000 | 5600 | 5600 | F | 200 |
| McDougald Road | NC 27 | 4.08 | ****PROPOSED**** | | | | | 50000 | 6250 | 6250 | F | 200 |
| NC 27 | Shawtown Road | 1.93 | ****PROPOSED**** | | | | | 30000 | 6750 | 6750 | F | 200 |
| Shawtown Road | NC 210 | 0.44 | ****PROPOSED**** | | | | | 30000 | 6100 | 6100 | F | 200 |
| NC 210 | US 401 | 3.78 | ****PROPOSED**** | | | | | 50000 | 3750 | 3750 | F | 200 |
| US 401 | McNeil Road/Prison Camp Road | 3.14 | ****PROPOSED**** | | | | | 50000 | 12900 | 12900 | F | 200 |
| McNeil Road/Prison Camp Road | US 401/421/NC 27/210 | 4.11 | ****PROPOSED**** | | | | | 30000 | 8200 | 8200 | F | 200 |

The future ADT's were projected using a trendline equation and not through the use of a computer model.

# Appendix B

# Thoroughfare Planning Principles

# THOROUGHFARE PLANNING PRINCIPLES

The primary mission of thoroughfare planning is to assure that the road system will be progressively developed to serve future travel desires. Therefore, provisions are made for street and highway improvements so that when the need arises, feasible opportunities to make improvements exist.

## Benefits of Thoroughfare Planning

The two major benefits derived from thoroughfare planning are: (1) the design of each road or highway to perform a specific function and provide a specific level of service, and (2) the reporting of future improvements to local officials for their possible incorporation into planning and policy decisions. Roads performing a specific function allows for savings in right-of-way, construction, and maintenance costs. Providing a specific level of service for roads allows for protection of residential neighborhoods and encouragement of stability in travel and land use patterns. Informing local officials of the thoroughfare plan:

(1) permits developers to design subdivisions in a non-conflicting manner,
(2) directs school & park officials to better locations of their facilities, and
(3) minimizes the damage to property values and community appearance sometimes associated with roadway improvements.

## Thoroughfare Classification Systems

Streets give traffic service and land access to the public. The fact that streets combine these two functions together creates conflict due to the incompatibility of these functions. The conflict is not serious if both traffic and land service demands are low. High demands and uncontrolled, intensely developed abutting property, however, create intolerable traffic flow friction and congestion.

The underlying concept of the thoroughfare plan is that it provides a functional system of streets, permitting travel from origins to destinations with directness, ease and safety. Different streets in this system are designed and are essential to perform specific functions, thus minimizing the traffic and land service conflict.

### *Urban Classification*

In the urban thoroughfare plan, elements are classified as major thoroughfares, minor thoroughfares, or local access streets.

Major Thoroughfares are the primary traffic arteries of the urban area providing for traffic movements within around, and through the area.
Minor Thoroughfares are designed to collect traffic from the local access streets and carry it to the major thoroughfare system.
Local Access Streets provide access to abutting property. Local streets may be further classified as either residential commercial and/or industrial depending upon the type of land use that they serve.

**Idealized Major Thoroughfare System**

The coordinated system of major thoroughfares that is most adaptable to the desired lines of travel within an urban area and that is reflected in most urban area thoroughfare plans is the radial-loop system. The radial-loop system includes radials, crosstowns, loops, and bypasses.

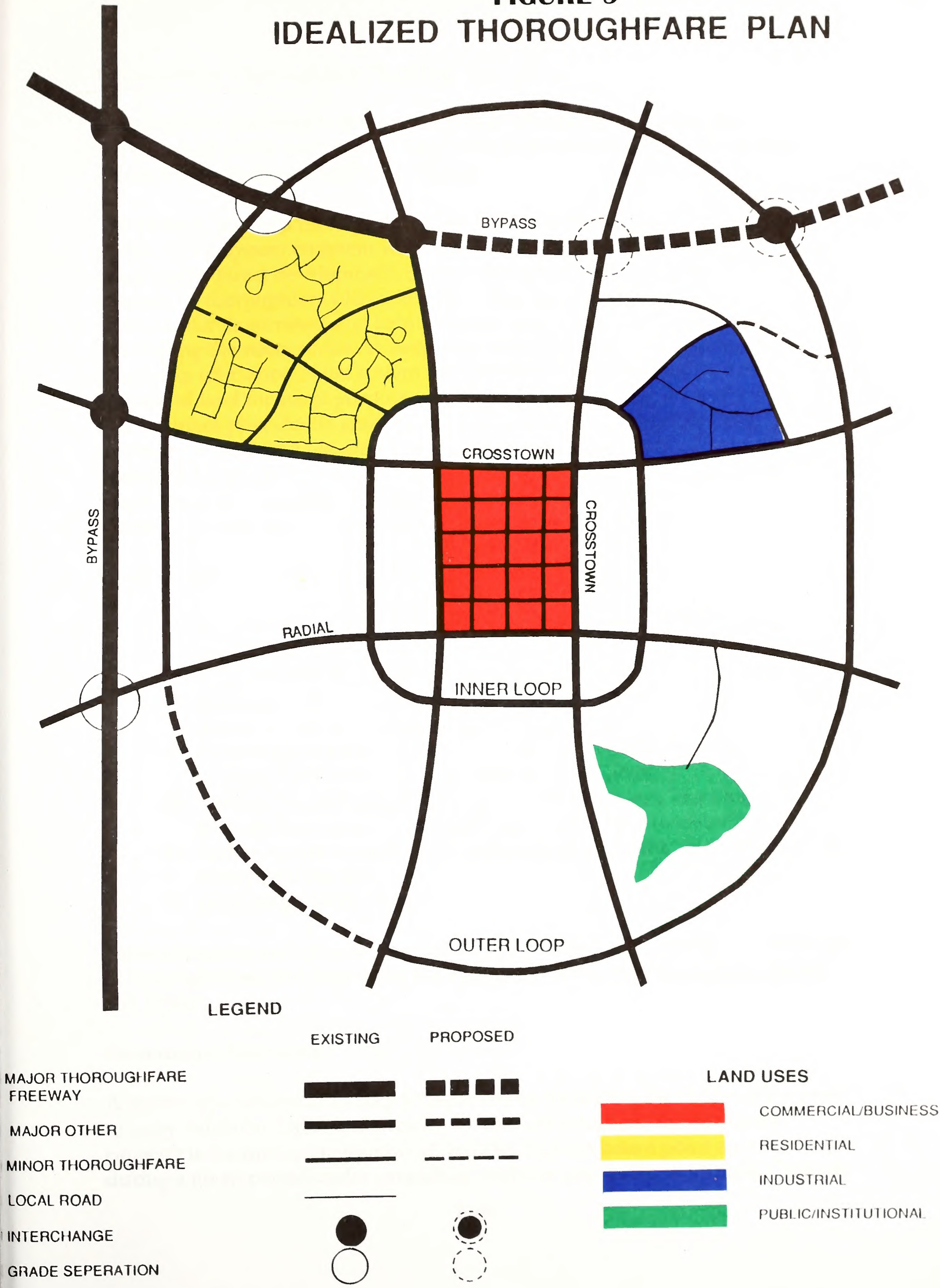
Radial streets provide for traffic movement between points located on the outskirts of the city and the central area. This is a major traffic movement in most cities, and the economic strength of the central business district depends upon the adequacy of this type of thoroughfare.

If all radial streets crossed in the central area, an intolerable congestion problem would result. A system of crosstown streets forming a loop around the central business district would avoid this problem. This system allows traffic moving from origins on one side of the central area to destinations on the other side to follow the area's border. It also allows central area traffic to circle and then enter the area near a given destination. The effect of a good crosstown system is to free the central area of crosstown traffic, thus permitting the central area to function more adequately in its role as a business or pedestrian shopping area.

Loop system streets move traffic between suburban area of the city. Although a loop may completely encircle the city, a typical trip may be from an origin near a radial thoroughfare to a destination near another radial thoroughfare. Loop streets can carry heavy volumes of traffic; their major function is to help relieve central areas. Depending on the size of the urban area, more than one loop street may be needed. If this is the case, the loop streets are generally spaced 1/2-mile to one mile apart, depending on the intensity of land use.

A bypass is designed to carry traffic through or around the urban area, thus providing relief to the city street system by removing traffic that has no desire to be in the city. Designed at through-highway standards, access to the bypasses are restricted. Some bypasses with low volumes can function as part of an urban loop. Bypasses are created to expedite the movement of through traffic and to improve traffic conditions within the city. By freeing the local streets for use by shopping and home-to-work traffic, bypasses tend to increase the economic vitality of the local area. Figure 9 shows an idealized thoroughfare plan map.

# FIGURE 9
# IDEALIZED THOROUGHFARE PLAN



**Objectives of Thoroughfare Planning**

Thoroughfare planning is the process public officials use to assure the development of the most appropriate street system to meet the existing and future travel desires within the urban area.

The primary aim of a thoroughfare plan is to guide the development of the street system in a manner consistent with changing traffic demands. Through proper planning for street development, costly errors and needless expense can be averted. A thoroughfare plan will enable street improvements to be made as traffic demands increase, and help eliminate unnecessary improvements. By developing the street system to keep pace with increasing traffic demands, a maximum utilization of the system can be attained that will require a minimum amount of land for street purposes. In addition to providing for traffic needs, the thoroughfare plan should embody those details of good urban planning necessary to present a pleasing and efficient urban community. The location of present & future population and commercial & industrial enterprises, affects major street and highway locations. Conversely, the location of major streets and highways within the urban area will influence the urban development pattern.

Other objectives of a thoroughfare plan include:

1) Providing for the development of an adequate major street system as land development occurs;
2) Reducing travel and transportation costs;
3) Reducing the cost of major street improvements to the public through the coordination of street system with private action;
4) Enabling private interests to plan their action, improvements, and development with full knowledge of public intent;
5) Minimizing disruption and displacement of people and businesses through long range planning for major street improvements;
6) Reducing environmental impacts such as air pollution, resulting from transportation; and
7) Increasing travel safety.

These objectives are achieved through improving both the operational efficiency of thoroughfares, and improving the system efficiency by system coordination and layout.

**Operational Efficiency**

A street's operational efficiency is improved by increasing the ability of the street to carry vehicular traffic and people. In terms of vehicular traffic, a street's capacity is the maximum number of vehicles that can pass a point on a roadway during a given period under prevailing roadway and traffic conditions. Capacity

is affected by the physical features of the roadway, nature of traffic, and weather.

Physical ways to improve vehicular capacity include:

<u>Street Widening</u>: widening a street from two to four travel lanes at least doubles the capacity by providing additional maneuverability for traffic.
<u>Intersection Improvements</u>: the increase of the turning radii, the addition of exclusive turn lanes, and the channelization of movements improve the capacity of an existing intersection.
<u>Improving vertical and horizontal alignment</u>: this reduces the congestion caused by slow moving vehicles.
<u>Eliminating roadside obstacles</u>: this reduces side friction and improves a driver's field of sight.

Operational ways to improve street capacity include:

<u>Control of access</u>: a roadway with complete access control can often carry three times the traffic handled by a non-controlled access street with identical lane width and number.
<u>Parking relocation</u>: Relocating on-street parking to an off-street site increases capacity by providing added street width for traffic flow and reducing friction to traffic flow caused by parking and unparking vehicles.
<u>One-Way operation</u>: the capacity of a street can sometimes by increased 20-50% (depending upon turning movements and street width), by initiating one-way traffic operations. One-way streets improve traffic flow by decreasing potential traffic conflicts and simplifying traffic signal coordination.
<u>Reversible Lanes</u>: may be used to increase street capacity in situations where heavy directional flows occur during peak periods.
<u>Signal phasing and coordination</u>: uncoordinated signals and poor signal phasing restrict traffic flow by creating excessive stop-and-go operation.

Travel demand can be altered to improve the efficiency of existing streets by:
<u>Carpools</u>: use of carpools can reduce the number of vehicles on the roadway and raise the people-carrying capability of the street system.
<u>Alternate mode</u>: alternate travel modes (i.e., transit, bicycles) can be used.
<u>Work hours</u>: industries, businesses and institutions staggering work hours or creating variable work hours for employees will reduce travel demand in peak periods and spread peak travel over a longer period.
<u>Land use</u>: a more travel-efficient land use development or redevelopment should be encouraged.

## System Efficiency

Another means of altering travel demand is the development of a more efficient system of streets that will better serve travel desires. A more efficient system can reduce travel distances, time, and cost. Improvements in system efficiency can be achieved through the concept of functional classification of streets and development of a coordinated major street system.

## Application of Thoroughfare Planning Principles

The concepts presented in the discussion of operational efficiency, system efficiency, function classification, and idealized major thoroughfare system are some tools available to the transportation planner to develop a thoroughfare plan. In truth, thoroughfare planning is done for existing urban areas and curbed by existing land use and street patterns, existing public attitudes and goals, and current expectations of future land use. Compromises must be made because of these and many other factors that affect major street locations.

Throughout the thoroughfare planning process, certain basic principles must be followed as closely as possible from a practical viewpoint. These principles are:

1) The plan should be derived from a thorough knowledge of today's travel, its features, and any contributing, limiting, or modifying factors.
2) Traffic demands must be sufficient to the kind and development of each major street. The thoroughfare plan should allow for a large portion of major traffic movements on a few streets.
3) The plan should adapt and cater to the area land development plan.
4) Urban development beyond the current planning period must be considered. In outlying or sparsely developed areas with development potential, thoroughfares must be denoted on a long-range planning basis to protect rights-of-way for future thoroughfare development.
5) While being consistent with the above principles and realistic with travel trends, the plan must be economically feasible.

# Appendix C

# Implementation Of The Thoroughfare Plan

Once the thoroughfare plan has been developed and adopted, implementation is essential. Unless implementation is an integral part of the thoroughfare plan process, the effort and expense associated with developing the plan is lost. There are several tools available for use by the Towns of Lillington to assist in the implementation of the thoroughfare plan for this area. They are listed below.

**State-Municipal Adoption of the Thoroughfare Plan**

If the town of Lillington had adopted the plan and the North Carolina Department of Transportation would have mutually approved the thoroughfare plan, as shown in Figure 2, the mutually approved plan could have served as a guide for the Department of Transportation in the development of the road and highway system for the planning area. The approval for the plan by the Town would have enabled standard road regulations and land use controls to be used effectively in the incorporation of this plan. If the plan was adopted, the Town and Department of Transportation would have reached agreement on the responsibilities for existing and proposed streets and highways. State-maintained facilities will be constructed and maintained by the Divisions of Highways; municipal-maintained facilities will be constructed and maintained by the municipality.

To neglect the implementation process is a three-fold loss: the loss of the capital expenditures used in developing a plan, the opportunity cost of the capital expenditures, and more importantly, the loss of the benefits to accrue from an improved transportation system.

**Subdivision Controls**

Subdivision regulations require every subdivider to submit to the Town Planning Commission a plan of any proposed subdivision. The regulations also require that these areas be constructed to certain standards. Through this process, it is possible to require subdivision streets to conform to the thoroughfare plan and to reserve or protect necessary right-of-way for projected roads and highways that are to become part of the thoroughfare plan. The adequate construction of subdivision streets reduces maintenance costs and simplifies the transfer of streets to the State Highway System.

Projects in the Lillington area that could have been implemented or protected by subdivision ordinances are the NC 27 Widening, TIP Project R-2609 (US 401 widening to multi-lane facility as a future need), TIP Project R-2230 (NC 210 widening to multi-lane facility), and the proposed US 421 Bypass. Appendix H outlines the recommended subdivision design standards as they pertain to road construction.

### Zoning Controls

A zoning ordinance can be beneficial to thoroughfare planning by designating appropriate locations of various land uses and allowable densities of residential development. This provides a degree of stability on which to make future traffic projections and to plan streets and highways.

Other benefits of a good zoning ordinance are: (1) the establishment of standards of development which will aid traffic operations on major thoroughfares; and (2) the minimization of strip commercial developments which creates traffic friction and increases the traffic accident potential.

The zoning ordinances of Lillington should be structured to control strip development along the thoroughfares. Strip development along Main Street and at the US 401/421/NC 27/210 intersection north of the Cape Fear River has already increased; it can be controlled in these areas by town ordinances. Continuing to allow this type of development without strict zoning controls will increase traffic congestion in these areas.

### Land Use Controls

Land use regulations help to regulate future land development and minimize undesirable development along roads and highways. The land use regulatory system can improve highway safety by encouraging off-street parking and sufficient setbacks to provide for adequate sight distances. Right-of-way cost dedications and reservations play major roles in the ultimate cost of many facilities. In few cases will the municipality be able to enjoy the benefits of highway improvement without some form of investment.

These regulations would be applicable to facilities that are recommended to be widened to multiple lanes, such as US 401 from 0.1 mi west of a bridge (the northwestern planning boundary) to 0.5 mi south of the Joel Johnson Road/Becker Road (the southern planning boundary) and NC 210 from 0.3 mi north of Maime Upchurch Road (the northern planning boundary) to a bridge 0.7 mi south of Joel Johnson Road (the eastern planning boundary). Land use controls can help to ensure that these facilities will maintain their intended capacities by regulating the types of land use that develop along the roads.

### Development Reviews

Driveway access to a State-maintained street or highway is reviewed by the District Engineer's office and the Traffic Engineering Branch of the North Carolina Department of Transportation. In addition, any development expected to generate large volumes of traffic (e.g., shopping centers, fast food restaurants, or large industries) may be comprehensively studied by staff of the NCDOT Traffic

Engineering Branch, Planning and Environmental Branch, and/or Roadway Design Unit. If done at an early stage, it is often possible to improve the accessibility of the growth area while preserving the integrity of the thoroughfare plan.

US 401, US 421, and NC 210 should experience increased development throughout the planning period. The proposed US 421 Bypass should also experience increased development as well. Use of development regulations can help control increasing traffic and congestion along these roads.

**Funding Sources**

*Capital Improvements Program (CIP)*

A Capital Improvement Program for transportation is a long-range plan for spending money on street improvements, acquisition of rights-of-way and other improvements on the basis of projected revenues. Municipal funds should be available for construction of street improvements that are a municipal responsibility, right-of-way cost sharing on facilities designated as a Division of Highways responsibility, and advance purchase of right-of-way where such action is warranted. However, NC House Bill 1211 limits the role of municipalities to specific limits in project cost sharing.

*Transportation Improvement Program (TIP)*

NCDOT's Transportation Improvement Program is a document listing all major construction projects NCDOT plans for the next seven years. Similar to local CIP projects, TIP projects are matched with projected funding sources. Every two years when the TIP is updated, completed projects are removed, programmed projects are advanced, and, if funding is available, new projects are added.

During TIP public hearings, municipalities request projects to be included in the TIP. A Board of Transportation (NCBOT) member reviews all of the project requests in a particular area of the state. Based on the technical feasibility, need, and available funding, the board member decides which projects will be included in the TIP. In addition to highway construction and widening, TIP funds are available for bridge replacement projects, highway safety projects, public transit projects, railroad projects, and bicycle projects.

*Industrial Access Funds*

If an industry wishes to develop property that does not have access to a state-maintained highway and certain economic conditions are met, then funds may be made available for construction of an access road.

*Small Urban Funds*

Small Urban Funds are annual discretionary funds made to municipalities with qualifying projects. The maximum amount is $300,000 per year per project. A town may have multiple projects. Requests for Small Urban Fund assistance should be directed to the appropriate NCBOT member and the appropriate NCDOT Division Engineer.

*Powell Bill Program*

The Powell Bill (General Statutes 136-41.1 through 136-41.3) allocate funds to qualified incorporated cities and towns for the maintenance, construction, and reconstruction of local streets that are the responsibility of the municipalities. Lillington received $84,216.06 as 1996 Powell Bill Funds.

**The North Carolina Highway Trust Fund Law**[C-1]

The Highway Trust Fund Law was established in 1989 as a 13.5-year plan with four major goals for North Carolina roads and highways. These goals are:

1) to complete the remaining 2,768 km (1,716 mi) of four-lane construction on the 5,800 km (3,600 mi) North Carolina Intrastate System.
2) to construct a multilane connector in Asheville and portions of multilane loops in Charlotte, Durham, Greensboro, Raleigh, Wilmington, and Winston-Salem.
3) to supplement the secondary roads appropriation in order to pave, by 1999, 16,100 km (10,000 mi) of unpaved secondary roads carrying 50 or more vehicles per day, and all other unpaved secondary roads by 2006.
4) to supplement the Powell Bill Program.

In this planning period, Lillington should look forward to the paving of most, if not all, of its unpaved roads on the state-maintained system within the planning boundary. There will also be an increase in Lillington's Powell Bill Funds if these newly paved roads are in the Lillington Corporate Limits.

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[C-1] For more information on the Highway Trust Fund Law, contact the Program Development Branch of the NCDOT.

# Appendix D

# Environmental Concerns

Environmental considerations associated with highway construction have come to the forefront of the planning process. The legislation that dictates the necessary procedures regarding environmental impacts is the National Environmental Policy Act. Section 102 of this act requires the creation of an environmental impact statement (EIS) for road projects having a significant impact on the environment. Included in an EIS would be the project's impact on wetlands, water quality, historic properties, wildlife, and public lands. While this report does not cover the environmental concerns in as much detail as an EIS would, preliminary research was done on several of these factors and is included below.

**Threatened and Endangered Species**

The Threatened and Endangered Species Act of 1973 allows the US Fish and Wildlife Service to impose measures on the Department of Transportation to mitigate the environmental impacts of a road project on endangered plants and animals and critical wildlife habitats. By locating rare species in the planning stage of road construction, we are able to avoid or minimize these impacts.

The North Carolina Department of Environment, Health, and Natural Resources (NC DEHNR) was the source of the name and type of each endangered species and natural area or community that existed in Harnett County and the Lillington Planning Boundary. Eleven animals, six plants, and four significant natural heritage areas were identified as rare or significant within the planning boundary. The following is a list of the federally and state protected species located in the Lillington planning boundary.

<u>Rare animals</u>

| | |
|---|---|
| Alasmidonta undulata (Triangle Floater) | T |
| Elliptio folliculata (Pod Lance) | |
| Elliptio roanokensis (Roanoke Slabshell) | T |
| Euphyes bimacula (Two-spotted skipper) | |
| Fusconaia masoniolla (Atlantic Pigtoe) | T |
| Lampsilis cariosa (Yellow Lampmussel) | T |
| Notropis mekistocholas (Cape Fear shiner) | EF |
| Strophitus undulatus (Squawfoot) | T |
| Villosa constricta (Notched Rainbow) | |

<u>Rare plants</u>

| | |
|---|---|
| Rudbeckia heliopsidis (Sun-facing Coneflower or Black-eyed Susan) | EF |

The following is a list of the federally and state protected species located just outside the Lillington planning boundary (near the Raven Rock State Park).

Rare animals

Sciurus niger (Eastern Fox Squirrel)
Tachopteryx thoreyi (Gray Petaltail dragonfly)

Rare plants

Cardamine douglasii (Douglas' Bittercress)
Enemion biternatum (Eastern Isopyrum)
Phacelia covillei (Buttercup Phacelia)
Rhynchospora scirpoides (Long-beak Baldsedge)
Tradescantia virginiana (Virginia Spiderwort)

EF: seen as an endangered species by the State and Federal Governments. An endangered species is one "in danger of extinction throughout all or a significant portion of its range."[1]

E: seen as an endangered species by the State Government only.

TF: seen as a threatened species by the State and Federal Governments. A threatened species is one "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."[1]

T: seen as a threatened species by the State Government only.

([1]Definitions are taken from the *Federal Register*, Vol. 56, No. 225, November 1, 1991 (50 CFR Part 17).)

Out of these endangered plants and animals, the habitat of four species may be affected by roads proposed to be built in this thoroughfare plan. However, special care will be taken during the project planning stage of these projects to insure the protection of the area.

**Wetlands**

In general terms, wetlands are areas where saturation with water is the dominant factor in determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. The single feature that most wetlands share is soil or substrate that is at least periodically saturated with or covered by water. Water creates severe physiological problems for all plants and animals except those that are adapted for life in it or in saturated soil.
Wetlands are crucial ecosystems in our environment. They help regulate and maintain the hydrology of our rivers, lakes, and streams by slowly storing and releasing flood waters. They help maintain the quality of our water by erosion. They are also critical to fish and wildlife populations. Wetlands provided an important habitat for about one third of the land and animal species that are federally listed as threatened or endangered.

In this study, the impacts to wetlands were determined using the National Wetlands Inventory Mapping, available from the U.S. Fish and Wildlife Service.

Wetlands impacts should be avoided or minimized to the greatest extent possible while preserving the integrity of the transportation plan. The following is a list of the federally and state protected areas in the Lillington planning boundary.

Significant Natural Heritage Areas

- Raven Rock State Park and Vicinity; this includes:
  - Basic Mesic Forest
  - Piedmont/Mountain Levee Forest
  - Floodplain pool
  - Piedmont Longleaf Pine Forest
- Neills Creek Aquatic Habitat
- Harnett Sunfacing Coneflower Site
- Dry Oak-Hickory Forest

**Historic Sites**

The locations of historic sites in the Lillington planning area were investigated to determine the possible impacts of the proposed transportation improvements. The federal government requires all State Departments of Transportation to make special efforts to preserve historic sites. Section 106 of the National Historic Preservations Act requires the Department of Transportation to identify historic properties listed in the National Register of Historic Places and properties eligible to be listed. The NC DOT must consider the impact of its road projects on these properties and consult with the Federal Advisory Council on Historic Preservation.

In addition to federal guidelines, the State of North Carolina has issued its own guidelines for historic site preservation. The NC General Stature 121-12(a) requires the NC DOT to identify historic properties listed on the National Register, but not necessarily those eligible to be listed. NC DOT must consider impacts and consult with the NC Historical Commission, but it is not bound by their recommendations.

The buildings or areas that are listed on the State Study List are:

(1) the Summervilla/McKay-Salmon House, and
(2) the Summerville Presbyterian Church and Cemetery

Both of these places are located off of Old US 421. Depending on the major thoroughfare proposed for the bypass, these areas could be impacted; however, the impact will be minimal. There are other buildings located in downtown Lillington that could be registered as a national historic site; they have not been determined as of yet.

# Appendix E

# Public Involvement

One of the goals of a thoroughfare plan is to conduct a study that (1) uses comprehensive and complete information, (2) is a never-ending or continuing process, and (3) shows cooperation with the town agencies and public. This appendix shows discussions with Lillington agencies and the public to determine issues of importance to them.

**Meetings**

On November 28, 1991, the Town of Lillington requested NCDOT to conduct an update study of the Thoroughfare Plan for the Lillington Planning Area.

From 1995 to the present, members of the Lillington and Harnett County Governments and the public have been contacted on a regular basis by the NCDOT Statewide Planning Branch to discuss the thoroughfare planning process and any recommendations that were needed for the Lillington Planning Area.

Several meetings were held with Harnett County Planners and a representative of the town of Lillington. Many issues were discussed, including the following:

1) The intersection of US 401/421/NC 27/210 (Main Street) and Duncan Street and the accidents occurring at this intersection
2) The new governmental complex to be built near the US 401/421/ NC 27/210 intersection (north of the Cape Fear River) and the increase of traffic to be generated by it
3) Increased truck traffic generated by sand quarries along US 401 and McNeil Street/Prison Camp Road (SR 2016)
4) The need for US 401 (between Lillington and Fayetteville) and NC 210 (between Lillington and Spring Lake) to become a four-lane facility
5) The need for a second Cape Fear River bridge
6) The route to the This End Up Furniture Plant (SR 1321) could be used as a route for a proposed bypass

From these discussions and analyses of the transportation system in the county, a set of preliminary recommendations were developed. On February 25, 1997, NCDOT introduced the thoroughfare planning process at a Lillington Town Council Meeting. Among the major projects proposed at this meeting were:

1) The six alternatives of the US 421 Bypass.
2) Widenings of several state-maintained roads to 24 ft for safety reasons, including NC 27 (from US 401/NC 210 (Main St) to the western Lillington planning boundary) and McNeil Street/Prison Camp Road (from 0.8 mi east of the railroad tracks to the eastern Lillington planning boundary).

There were several requests and concerns brought out by local officials. The NCDOT speaker presented the information in a format which seemed to bulldoze the Town Council with recommendations instead of suggesting ideas to the Council

There were several requests and concerns brought out by local officials. The NCDOT speaker presented the information in a format which seemed to bulldoze the Town Council with recommendations instead of suggesting ideas to the Council for their input. However, this matter was clarified, and NCDOT suggested to have a worksession where these matters could be discussed further.

The worksession with the NCDOT and the Lillington Town Council occurred on April 22, 1997. The worksession occurred for NCDOT to present population and employment estimates and obtain definite town population and employment amounts along with the amount of expected growth of Lillington from the Town Council. The topics discussed (with *responses*) were:

1) Land use of the planning area, including areas to be annexed (along US 421 South/NC 27 East, surrounding NC 210 North, along US 421 North (to Sanford) and between US 421 and Old US 421), industrial and commercial zones, and single-family, two-family residences (RA-30).
2) Deficiencies of transportation system within planning area:
    a) No roads have existing ADT's that are over capacity. Future ADT's will be determined when expected growth amount of the area is defined. US 401 estimates exceed capacity in the design year.
    b) The larger amount of truck traffic travels along US 401, which have caused complaints from people attempting to park along the Main St area. *The Town Council stressed that there is a large amount of traffic that crosses the Cape Fear River bridge and also on NC 210 and US 401 South.*
    c) The through and external-internal traffic traveling through Lillington will have a large impact on the modeling process used for the planning area.
3) Population, employment and housing growth for the planning area and Harnett County:
    a) Population and housing growth were estimated. These numbers are to be confirmed by the town manager. *The Town Council stated that the northern part of the planning boundary is where a lot of the population growth is expected to occur, due to the population increase in the Triangle area and that growth spilling over into Angier & northern Harnett County.*
    b) Based on the low growth population increase estimated and the present employment-population ratio (1996), an increase of almost 1600 employees was calculated for the design year (2025). *The Town Council informed NCDOT that these numbers looked low to them. Champion Industries are just hiring 150 new employees (which is a tenth of the estimates NCDOT gave for the next 28 years).*
4) Solutions to the deficiencies listed above:
    a) Removal of parking privileges along Main Street to eliminate conflicts with truck and parking traffic.

*US 401 South. The Town Council does not want a second Cape Fear Bridge built east of the existing one. They stated that the land in that area is very valuable to them and the town and they hope to annex that area (along with other areas within the planning boundary). This knowledge would eliminate most of the bypass alternatives.*

The town of Lillington requested a study delay on March 25, 1998 until early 1998.

# Appendix F

## Traffic Model Development

In order to develop an efficient Thoroughfare Plan for the Town of Lillington, a traffic model was developed and calibrated. Base year traffic counts, socioeconomic data (housing counts and an employment survey/estimate), trip generation characteristics of the study area, and future (design year) estimates of socioeconomic data are needed for model development. The base year information is used to develop a calibrated traffic model of the existing street network. Once the model is calibrated to the base year, the future socioeconomic data is applied to the model and the future traffic demand on the existing street network can be examined and problem areas identified. At this point, the model can evaluate the effectiveness of various alternatives (or solutions) in addressing these identified problem areas.

**The Planning Area**

The planning area for the town of Lillington was defined by including the current city limits and the outlying areas that are projected to develop by the design year 2025. The planning area was divided into four sections using screenlines. A screenline is an imaginary line drawn across either a portion of or the entire planning area. Two screenlines were used: (1) north-south located just west of NC 210 and parallel to the path of NC 210; and (2) east-west traversing concurrently with the Cape Fear River to the town limits, then running parallel and finally concurrent with the railroad line to the western planning boundary. Counts are taken at every street that crosses these lines and are then summed for a total volume of traffic crossing the screenline. These screenlines and counts were later used in the model calibration process (the process by which various factors are adjusted to duplicate existing travel patterns as accurately as possible). The planning area was then further divided into 43 traffic zones for data collection and aggregation. These zones reflect similar land use within the zone. The planning area, screenlines, and traffic zones are shown in Figure 10.

**The Base Year Network**

The purpose of the traffic model is to duplicate the conditions of the existing town street system. Therefore, it is necessary to represent the existing street system in the model. There is a balance between having too many streets on the model to allow it to be calibrated and not enough streets to realistically duplicate existing conditions. Generally, all the major arterials and some of the major land access or collector streets need to be represented.

Several criteria are used to select the base year network: (1) engineering judgment based on general knowledge of the study area; (2) traffic counts (to determine the location of significant traffic), and (3) the previous thoroughfare plan (to determine existing major and minor thoroughfares). Though several local roads were included in the base year network, most of the local roads were represented by connections between traffic zone centroids and modeled streets. The resulting study area base year network is shown in Figure 11.

Speed and distance define the minimum time paths from zone to zone. The model uses the minimum time paths as a basis for assigning traffic to the network. Street capacity is

also an important component of the model. The volume/capacity ratio (v/c) gives us our best indication of present and future traffic congestion.

## Data Requirements

Two types of data are needed to develop an adequate traffic model. First, traffic counts on streets used in the network provide a basis for calibration. These traffic counts show a snapshot of traffic conditions in the study area. Next, socioeconomic data (collected for each traffic zone) generate traffic for the model. The socioeconomic data for the model area is shown in Appendix G.

### *Traffic Counts*

The model must be calibrated against existing conditions in the study area. In order to calibrate the model traffic counts were taken at various locations throughout the study area. Traffic counts for the study area were collected in July and August of 1996. Traffic volumes generated during the modeling process were compared to these average summer weekday counts and to Annual Average Daily Traffic counts (AADT's) that were factored to represent an average summer weekday during the calibration process. The counts taken at the outskirts of the planning area boundary represent the amount of traffic entering and exiting the planning area on an average summer weekday in 1996.

### *Socioeconomic Data*

Housing data (including apartments) were collected at the zone level and were classified into five categories: excellent; above average; average; below average; and poor. The employment data was collected by a combination of surveying the area for the businesses and gathering 1995 information from the ESC. The ESC information was updated for 1996 by contacting each employer to determine the number of employees and commercial vehicles at that location. This data was then grouped into five categories based on Standard Industrial Codes (SIC): industrial; other retail/wholesale; highway retail; service; and office.

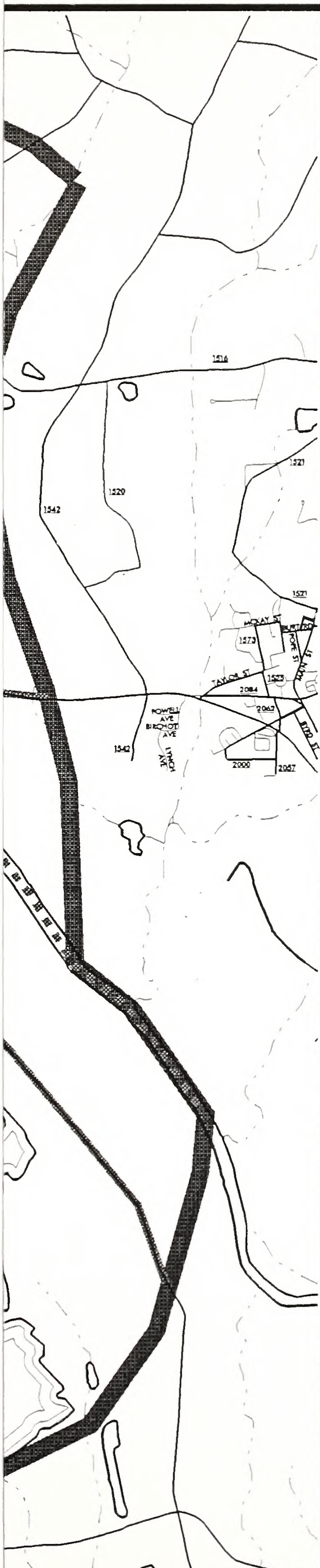
## The Four Step Process

The calibrated traffic model was based on the traditional four step planning process: trip generation; trip distribution; mode choice; and trip assignment. These steps were used to simulate the area's 1996 traffic patterns.

### *Trip Generation*

Trip generation is the process by which external station volumes, housing and employment data are used to generate traffic volumes simulating the street network traffic volumes.

Traffic inside the study area has three major components: through trips (external-external), internal-external trips, and internal-internal trips. These terms are explained here.



LEGEND

ZONE LINE

SCREEN LINE

PLANNING AREA BOUNDARY

Figure 10

## ZONE MAP

# LILLINGTON

HARNETT COUNTY
NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS – GIS UNIT

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 2 4 6 8
miles

0 1 2 3
kilometers

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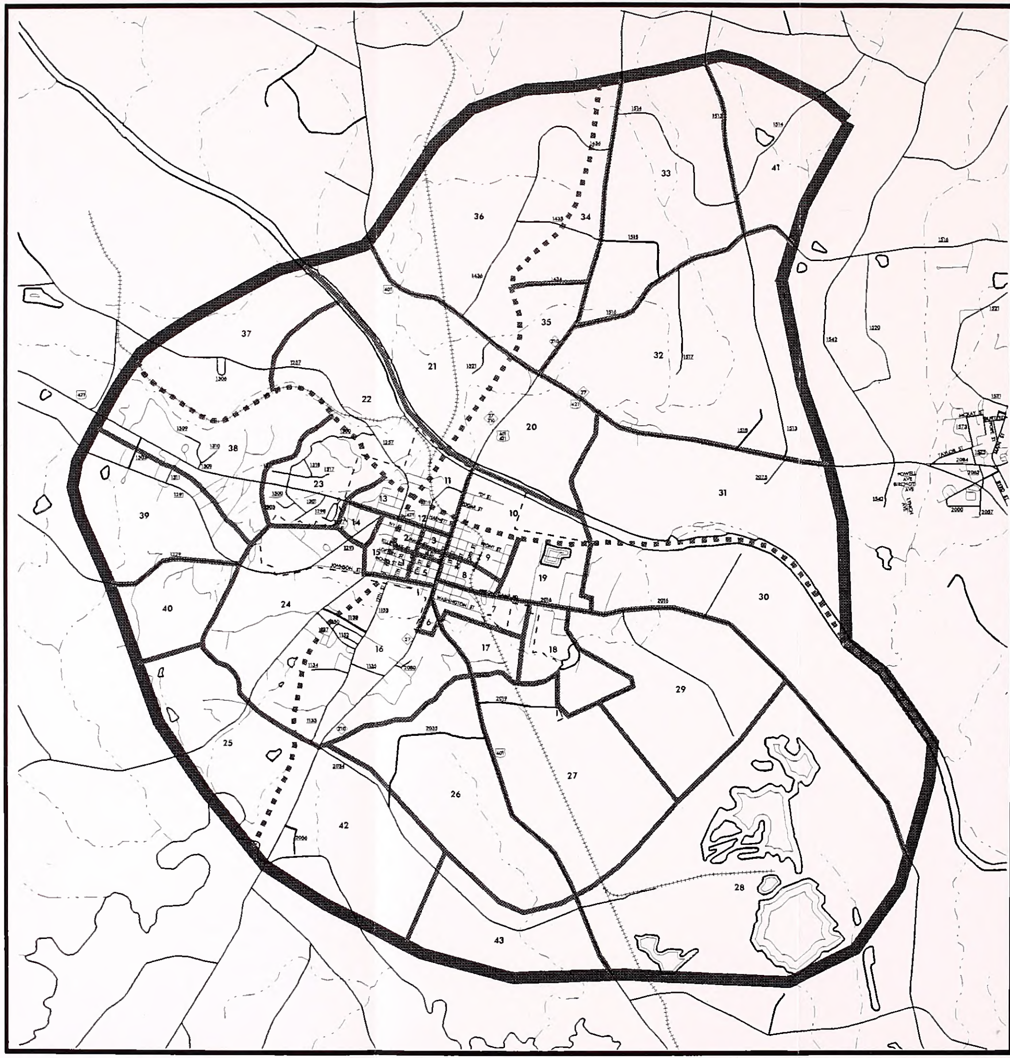

## LEGEND

ZONE LINE

SCREEN LINE

PLANNING AREA BOUNDARY

Figure 10

# ZONE MAP

# LILLINGTON

HARNETT COUNTY
NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
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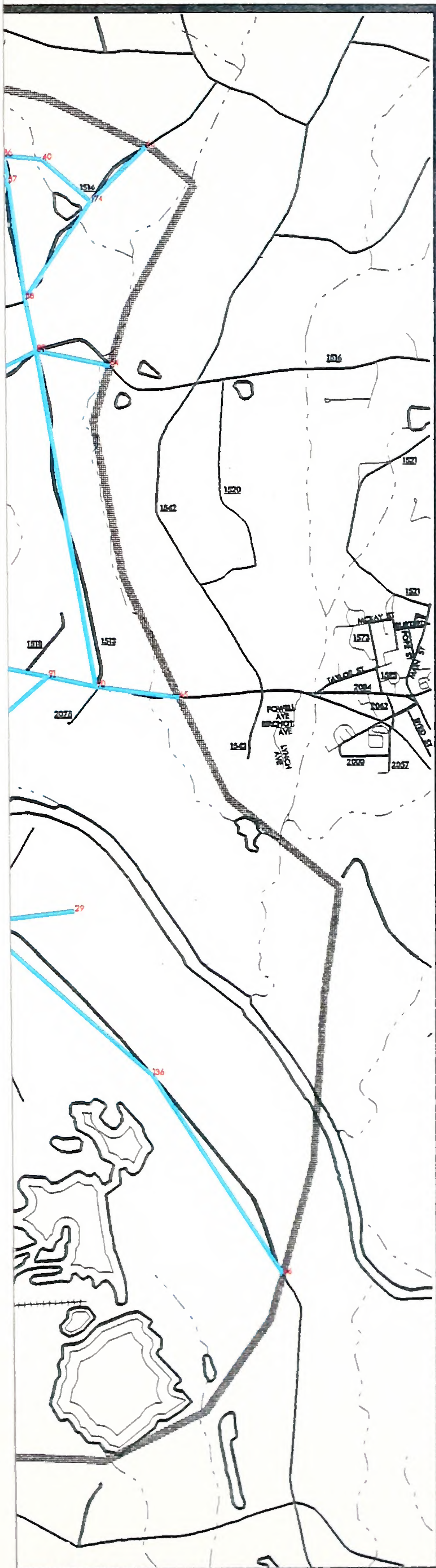
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 2 4 6 8
miles

0 1 2 3
kilometers




## LEGEND

Node 00

Link

Planning Area Boundary

Figure 11

# TRANPLAN NETWORK

# LILLINGTON

HARNETT COUNTY
NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - GIS UNIT

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 2 4 6 8

miles

0 1 2 3

kilometers

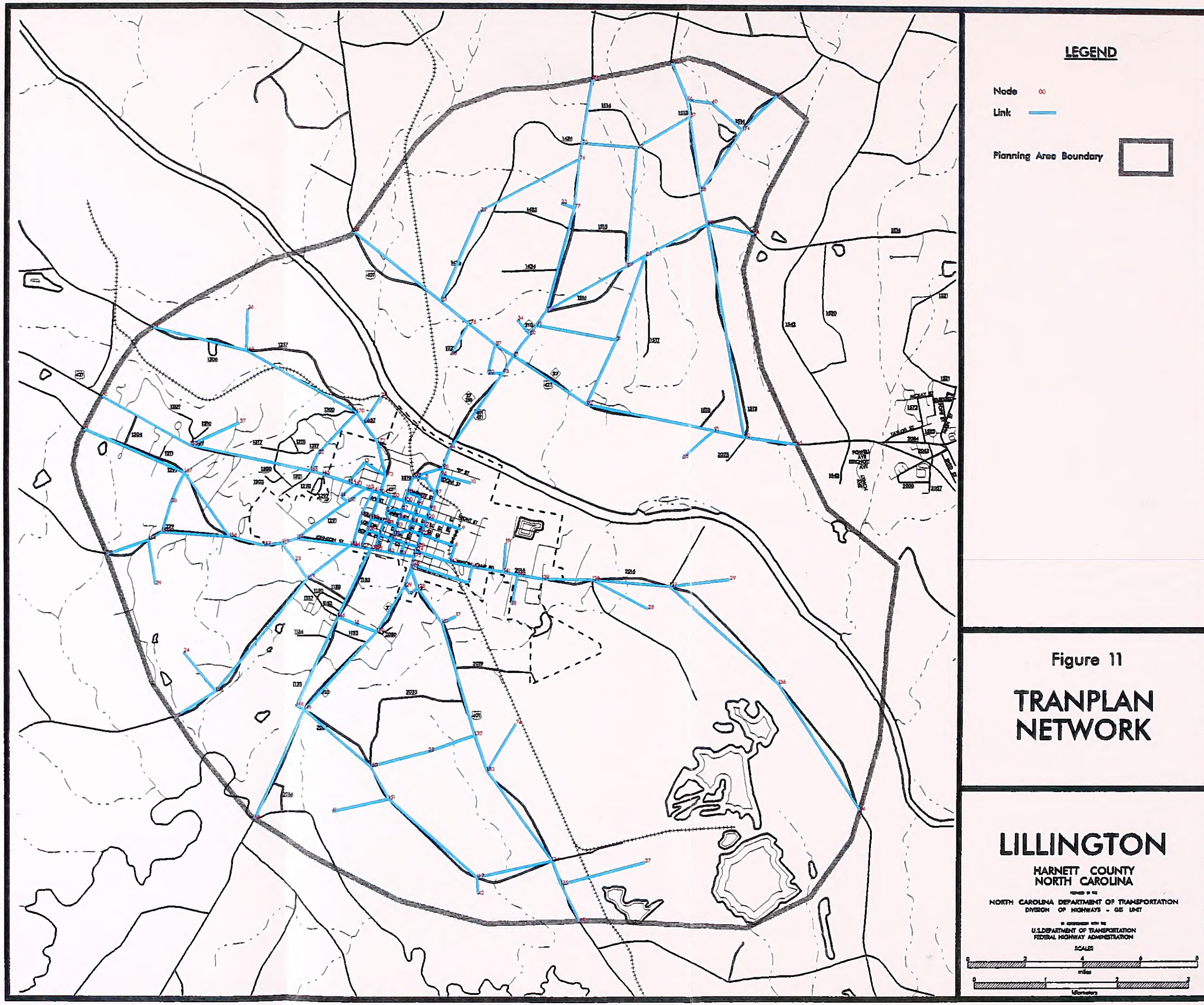

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Figure 11
TRANPLAN NETWORK
LILLINGTON
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SCALES
miles
kilometers

*Through Trips*

Through trips are produced outside the planning area and pass through the planning area enroute to a destination outside the planning area. They were developed based on the average daily traffic (ADT) counts taken at major roads on the planning boundary. These ADTs were used in the SYNTH program to create a base year through trip table. The SYNTH program is depicted in Technical Report 3 (Synthesized Through Trip Table for Small Urban Areas by David G. Modlin, Jr.). SYNTH creates the through trip table using a set of regression equations and these input data: planning area population, functional classification of the cordon stations, percent trucks at the cordon stations, route continuity, along with the ADT's at the cordon stations. Through trips in this area are higher because Lillington lies between the Raleigh and Fayetteville Urban Areas. See Table 6 for a summary of the through trip analysis.

**Table 6**
**1996 Cordon Station Summary**

| Cordon Station Name | % Thru Trips | 1996 Traffic Counts | 1996 Through Trip-Ends | 1996 Ext-Int Trips |
|---|---|---|---|---|
| NC 210 EAST | 70 | 5100 | 3570 | 1530 |
| SR 1513 | 30 | 900 | 270 | 630 |
| SR 1514 | 25 | 300 | 75 | 225 |
| SR 1516 | 35 | 800 | 280 | 520 |
| US 421 S/NC 27 N | 80 | 12600 | 10080 | 2520 |
| SR 2016 | 45 | 1850 | 833 | 1018 |
| US 401 SOUTH | 80 | 6050 | 4840 | 1210 |
| NC 210 WEST | 70 | 6700 | 4690 | 2010 |
| NC 27 SOUTH | 50 | 3400 | 1700 | 1700 |
| SR 1229 | 30 | 900 | 270 | 630 |
| SR 1291 | 30 | 1500 | 450 | 1050 |
| US 421 NORTH | 75 | 6950 | 5213 | 1738 |
| SR 1257 | 30 | 750 | 225 | 525 |
| US 401 NORTH | 80 | 8050 | 6440 | 1610 |

The future year through trip table was created using the FRATAR program in TRANPLAN. The FRATAR program increases the base year through trip table to the future year by using the growth rate factor at each station. This factor was developed based on a trendline analysis of the external stations and knowledge of future and potential land use changes just outside the planning boundary.

*External↔Internal (E↔I) Trips*

External↔internal trips have one end of the trip outside of the planning area. They are calculated by subtracting the number of through trip-ends at each cordon station from the total traffic volume at that station.

*Internal Trips*

Internal-internal trips have both their origin and destination inside the planning area. For clarity, the internal trips are further subdivided into trip purposes. The trip

purposes for Lillington are home-based work (HBW), other home based (OHB), and non-home based (NHB). These trip purposes were calculated using an in-house program called Internal Data Summary (IDS). IDS calculated the trip productions and trip attractions for each traffic analysis zone (TAZ). IDS multiplies the number of dwelling units by the appropriate generation rate to determine the Trip Productions by TAZ. Table 7 shows the base year generation rates used in the study. IDS then uses regression equations to calculate the trip attractions by trip purpose and by TAZ. A copy of the IDS input variables and regression equations are shown below. The IDS housing employment data for the base and future years are shown in Appendix G.

**Table 7**
**1996 Trip Generation Rates**

| Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|
| 12 | 10 | 8 | 6 | 4 |

**Regression Equations**

HBW purpose: Trip Attractions = 1.00X1 + 1.00X2 + 1.00X3 + 1.00X4 + 1.00X5
OHB purpose: Trip Attractions = 0.20X1 + 1.83X2 + 8.36X3 + 2.55X4 + 2.60X5 + 0.50DU
NHB purpose: Trip Attractions = 0.40X1 + 1.83X2 + 8.36X3 + 2.55X4 + 2.60X5 + 0.50DU
E↔I purpose: Trip Attractions = 1.00X1 + 1.83X2 + 8.36X3 + 2.55X4 + 2.60X5 + 0.25DU

Where:
X1 → Industrial (SIC codes 1-49)
X2 → Other retail (SIC codes 50-54, 56, 57, 59)
X3 → Highway retail (SIC codes 55, 58)
X4 → Service (SIC codes 70-76, 78-89, 99)
X5 → Office (SIC codes 60-67, 91-97)
DU → Dwelling Unit

The remaining component of internal trips is made up of non-home based secondary trips (NHBS). Non-home based secondary trips are internally generated trips made by vehicles garaged outside the planning area. An example of this type of trip would be a trip to the grocery store on the way home from work where the grocery store and work are inside the planning area, and home is outside of the planning area. It was assumed that 40% of these externally garaged trips made a secondary trip while in the planning area. These trips were determined using the following equation:

NHB Secondary Trips = [Total Ext↔Int Trips - Int→Ext Trips Garaged Inside Planning Area] X 0.40

Running IDS required assigned percentages to be input for each trip type and trip purpose. Internal trips that remained inside of the planning area boundary consisted of 80% of the total internally generated trips. This resulted in 20% internal→external trips. (Trips which are generated internally but travel outside of the planning area.) Of the 80% internally generated permanent trips: 25% were home based work; 45% were home based other; and 30% were non-home based. (See Table 8.)

Table 8
Trip Generation by Purpose

| Int-Int | | Home Based Work | | Home Based Other | | Non-Home Based | |
|---|---|---|---|---|---|---|---|
| Percentage | Trips | Percentage | Trips | Percentage | Trips | Percentage | Trips |
| 80% | 11139 | 25% | 2785 | 45% | 5013 | 30% | 7581 |

*Trip Distribution*

The Gravity Model is used to distribute trips from one TAZ to another. The Gravity Model is based on Newton's gravity equation:

$$T_{ij} = \frac{(P_i)(A_j)(F_{ij})(K_{ij})}{\Sigma^n{}_{j=1}[(A_j)(F_{ij})(K_{ij})]}$$

Where:
i = Origination zone
j = Destination zone
n = Total number of zones
T = Number of trips produced in zone i and attracted to zone j
P = Number of trips produced in zone i
A = Number of trips attracted by zone j
F = Friction factor (or Travel Time Factor) from zone i to zone j
K = adjustment factor

The friction factor (F) is critical to the gravity model distribution and must be derived empirically. The friction factor is dependent on the distance between the TAZs, the time necessary to travel these distances, and the trip purpose. The friction factors for the study area were borrowed from other areas and calibrated for the Lillington Study Area. Table 9 shows the friction factor values used with each purpose.

**Table 9**
**Friction Factors for Residences**

| Time Interval | Home Based Work | Home Based Other | Non-Home Based | Ext-Int |
|---|---|---|---|---|
| 1 | 2000 | 791 | 2110 | 15414 |
| 2 | 7509 | 1325 | 3880 | 24312 |
| 3 | 25149 | 4292 | 7395 | 41650 |
| 4 | 46509 | 8924 | 14601 | 75628 |
| 5 | 84509 | 18435 | 9850 | 87731 |
| 6 | 71500 | 13550 | 6100 | 69150 |
| 7 | 40500 | 6480 | 4390 | 41250 |
| 8 | 20150 | 1876 | 2146 | 19740 |
| 9 | 5500 | 955 | 1039 | 9544 |
| 10 | 200 | 388 | 611 | 4230 |
| 11 | 0 | 0 | 189 | 900 |
| 12 | 0 | 0 | 0 | 0 |
| 13 | 0 | 0 | 0 | 0 |

Table 10 shows trip length frequency curves used in the calibrated gravity model.

**Table 10**
**Travel Curve Data**

| Time Interval | Home-Based Work | Home-Based Other | Non-Home Based | Ext-Int |
|---|---|---|---|---|
| 1 | 40 | 8 | 42 | 231 |
| 2 | 1502 | 159 | 272 | 851 |
| 3 | 6162 | 773 | 740 | 2499 |
| 4 | 7907 | 1963 | 2628 | 6050 |
| 5 | 8451 | 3042 | 1576 | 10089 |
| 6 | 5720 | 1355 | 915 | 10718 |
| 7 | 2430 | 518 | 439 | 5363 |
| 8 | 1008 | 94 | 172 | 2369 |
| 9 | 165 | 29 | 62 | 1050 |
| 10 | 5 | 8 | 24 | 338 |
| 11 | 0 | 0 | 6 | 54 |
| 12 | 0 | 0 | 0 | 0 |
| 13 | 0 | 0 | 0 | 0 |

### *Mode Choice*

Mode choice is the third step in the traditional four step process. This step predicts the travel that will be made by each available type of transportation. Typically, the two mode types analyzed are auto and transit. Auto was the only travel mode analyzed because Lillington operates without a transit system.

### *Trip Assignment*

Since the trip distribution has been determined, the trips must be loaded to the model network. The All-or-Nothing loading option was used for this purpose for the base and future years. This option loads all of the trips for one zone to another based on the minimum paths between the two zones.

### *Model Calibration*

The purpose of this model is to predict traffic on a street system at some future point in time. Therefore, the model must be calibrated to duplicate the existing traffic patterns on the current transportation system. Calibration of the model is an iterative process where incremental changes are made in the through trip table & the external-internal trip generation, the internal-internal trip generation, the trip distribution, or the street network. Each change occurs to represent the actual travel patterns occurring on the existing street network. Predicting future traffic can occur once the model accurately reflects the existing traffic.

**Level of Accuracy**

Two steps were taken to check the accuracy of the Lillington model. Comparing trips assigned by the model with the traffic counts taken at the screenlines is the first step. The model is considered to closely reflect the overall traffic patterns of the actual street system if the total number of trips counted across the screenlines are between 90% and 110% of the ground counts. This ensures that the correct amount of trips are being produced and that they are being attracted to the correct region of the model. Table 11 shows the comparison of ground counts with the generated traffic volumes for the Lillington study. The table shows that the base year model needs further calibration.

**Table 11**
**Actual vs. Model Screenline Totals**

| Screenline | Model Volume | Ground Count | Percent |
|---|---|---|---|
| A (North-South) | 28111 | 33300 | 84% |
| B (East-West) | 26291 | 25100 | 105% |

The final check on the model involves comparing loaded volumes on individual links to the ground counts on the same links in order to locate possible problems in the network.

***Design Year Projections***

To use the model, the base year socioeconomic data must be projected to estimate the future year socioeconomic data. These projections were developed by a collaboration between NCDOT's Statewide Planning Branch and the Lillington Town Council.

Total housing was projected by the Statewide Planning Branch based on past persons per dwelling unit trends and population trends. Then, the Statewide Planning Branch and the Lillington Town Council worked together to distribute these projections to each traffic zone based on the Lillington Land Use Plan.

Total employment was projected by the Statewide Planning Branch, and based on past employment and population trends. After the total number of employees was projected, the Statewide Planning Branch and the Lillington Town Council worked together to distribute these projections to each traffic zone based on the Lillington Land Use Plans. The socioeconomic data and projections are shown in Appendix G.

The Statewide Planning Branch also calculated the future year adjustments to the travel model input variables. These projections were used with the previously developed regression equations to produce trip productions and trip attractions in the same manner as the base year. Table 12 summarizes the trip generation rates, travel in the planning area, and projections.

## Table 12
## Travel Model Input Variables

| Year | 1996 | 2025 |
|---|---|---|
| Number of Housing Units | 2053 | 3736 |
| Planning Boundary Population | 4517 | 7117 |
| Number of Employees | 4340 | 6838 |
| Person/Dwelling Units | 2.20 | 2.20 |
| Persons/Vehicle | 1.47 | 1.10 |
| Housing Trip Generation Rates | | |
| Excellent | 12.00 | 14.20 |
| Above Average | 10.00 | 12.20 |
| Average | 8.00 | 10.20 |
| Below Average | 6.00 | 8.20 |
| Poor | 4.00 | 6.20 |
| Average Daily Trips/Dwelling Units | 6.78 | N/A |
| Type of Travel | | |
| Through Trips | 38935 | N/A |
| External-Internal Trips | 16915 | N/A |
| Internal Trips | 11139 | N/A |
| Home-Based Work (23%) | 2785 | N/A |
| Home-Based Other (50%) | 5013 | N/A |
| Non-Home Based (27%) | 3342 | N/A |
| Non-Home Based Sec. Trips | 4239 | N/A |
| Calculations for 2025 Generation Rates | | |
| Composite Factor = | | |
| 1996 Veh. Ownership x Usage Factor | x 2025 Person/DU = | |
| 2025 Veh. Ownership | 1996 Person/DU | |
| 1.47 x 0.99 | x 2.20 = | |
| 1.10 | 2.20 | |
| Composite Factor = | 1.32 | |
| Increase for 2025 Generation Rates = | | |
| (Avg 1996 Trip Rates x Composite Factor) - | Avg 1996 Trip Rates = | |
| (6.78 x 1.32) - | 6.78 = | 2.17 |

# Appendix G

# Lillington Planning Area Socioeconomic Data

The following tables show the input information needed for the TRANPLAN model to correctly assimilate the traffic flow throughout the planning area. The following index of abbreviations may be helpful in interpreting the tables.

- E, AA, A, BA, P - housing classification categories (excellent, above average, average, below average, poor)
- Apts - apartments
- Hwy Retail - SIC Group including automotive dealers, gasoline service stations, eating and drinking places
- SIC - Standard Industrial Classification (code used to rate businesses)
- Zone - traffic zone

Table 13
1996 Housing Data

| ZONE | E | AA | A | BA | P | Totals | |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 7 | 49 | 2 | 0 | 58 | |
| 2 | 0 | 1 | 34 | 1 | 0 | 36 | |
| 3 | 1 | 5 | 17 | 0 | 0 | 23 | |
| 4 | 2 | 3 | 3 | 0 | 0 | 8 | |
| 5 | 1 | 12 | 28 | 12 | 0 | 53 | |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 7 | 0 | 0 | 40 | 15 | 33 | 88 | |
| 8 | 0 | 4 | 51 | 19 | 6 | 80 | |
| 9 | 1 | 6 | 44 | 4 | 18 | 73 | |
| 10 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 11 | 0 | 0 | 26 | 0 | 0 | 26 | 26 apts |
| 12 | 1 | 0 | 2 | 3 | 7 | 13 | |
| 13 | 1 | 14 | 37 | 1 | 0 | 53 | |
| 14 | 2 | 12 | 23 | 2 | 1 | 40 | |
| 15 | 0 | 2 | 45 | 22 | 8 | 77 | |
| 16 | 0 | 3 | 27 | 31 | 133 | 194 | |
| 17 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 18 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 19 | 0 | 0 | 10 | 4 | 3 | 17 | |
| 20 | 0 | 0 | 5 | 2 | 2 | 9 | |
| 21 | 0 | 0 | 1 | 1 | 0 | 2 | |
| 22 | 1 | 8 | 47 | 6 | 4 | 66 | |
| 23 | 7 | 28 | 62 | 3 | 0 | 100 | |
| 24 | 1 | 7 | 65 | 21 | 40 | 134 | |
| 25 | 0 | 0 | 9 | 0 | 0 | 9 | |
| 26 | 1 | 1 | 14 | 10 | 101 | 127 | |
| 27 | 0 | 0 | 14 | 11 | 39 | 64 | |
| 28 | 0 | 0 | 17 | 5 | 3 | 25 | |
| 29 | 0 | 0 | 11 | 6 | 23 | 40 | |
| 30 | 0 | 3 | 11 | 5 | 13 | 32 | |
| 31 | 0 | 0 | 4 | 4 | 20 | 28 | |
| 32 | 1 | 4 | 37 | 27 | 39 | 108 | |
| 33 | 2 | 8 | 28 | 7 | 16 | 61 | |
| 34 | 0 | 7 | 8 | 4 | 4 | 23 | |
| 35 | 0 | 1 | 3 | 0 | 1 | 5 | |
| 36 | 0 | 9 | 19 | 5 | 25 | 58 | |
| 37 | 0 | 3 | 21 | 2 | 3 | 29 | |
| 38 | 18 | 40 | 23 | 4 | 1 | 86 | |
| 39 | 1 | 2 | 44 | 4 | 24 | 75 | |
| 40 | 0 | 0 | 1 | 0 | 3 | 4 | |
| 41 | 1 | 4 | 9 | 4 | 10 | 28 | |
| 42 | 0 | 3 | 16 | 10 | 46 | 75 | |
| 43 | 0 | 2 | 10 | 4 | 10 | 26 | |
| SUM = | 42 | 199 | 915 | 261 | 636 | 2053 | |
| | | Total Dwelling Units = | | | 2053 | | |

Table 14
1996 Employment Data

| # EMPLOYEES/ZONE | INDUSTRIAL | RETAIL | HWY RETAIL | OFFICE | SERVICE | |
|---|---|---|---|---|---|---|
| SIC GROUP # | 1 | 2 | 3 | 4 | 5 | |
| ZONE # | | | | | | Totals |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 3 | 0 | 0 | 9 | 52 | 64 |
| 3 | 18 | 24 | 15 | 33 | 66 | 156 |
| 4 | 0 | 3 | 5 | 2 | 0 | 10 |
| 5 | 0 | 5 | 29 | 1 | 122 | 157 |
| 6 | 0 | 68 | 55 | 0 | 11 | 134 |
| 7 | 147 | 58 | 0 | 0 | 4 | 209 |
| 8 | 1 | 15 | 8 | 0 | 6 | 30 |
| 9 | 5 | 10 | 7 | 155 | 50 | 227 |
| 10 | 4 | 0 | 22 | 69 | 38 | 133 |
| 11 | 75 | 5 | 40 | 5 | 1 | 126 |
| 12 | 5 | 6 | 10 | 173 | 22 | 216 |
| 13 | 0 | 0 | 0 | 0 | 2 | 2 |
| 14 | 0 | 90 | 32 | 6 | 15 | 143 |
| 15 | 2 | 8 | 0 | 0 | 12 | 22 |
| 16 | 247 | 7 | 0 | 0 | 173 | 427 |
| 17 | 3 | 0 | 1 | 0 | 0 | 4 |
| 18 | 0 | 0 | 0 | 558 | 0 | 558 |
| 19 | 414 | 0 | 0 | 133 | 16 | 563 |
| 20 | 18 | 23 | 48 | 12 | 9 | 110 |
| 21 | 313 | 0 | 0 | 75 | 0 | 388 |
| 22 | 2 | 5 | 0 | 0 | 20 | 27 |
| 23 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | 0 | 5 | 0 | 0 | 9 | 14 |
| 25 | 0 | 0 | 3 | 0 | 3 | 6 |
| 26 | 2 | 5 | 0 | 0 | 8 | 15 |
| 27 | 0 | 0 | 0 | 0 | 1 | 1 |
| 28 | 14 | 0 | 0 | 0 | 11 | 25 |
| 29 | 0 | 3 | 0 | 0 | 2 | 5 |
| 30 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31 | 0 | 0 | 0 | 0 | 2 | 2 |
| 32 | 29 | 8 | 13 | 0 | 171 | 221 |
| 33 | 11 | 3 | 0 | 0 | 3 | 17 |
| 34 | 3 | 0 | 0 | 0 | 2 | 5 |
| 35 | 0 | 0 | 79 | 0 | 28 | 107 |
| 36 | 10 | 0 | 2 | 0 | 0 | 12 |
| 37 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 0 | 0 | 2 | 20 | 22 |
| 39 | 0 | 0 | 0 | 0 | 136 | 136 |
| 40 | 7 | 0 | 0 | 0 | 0 | 7 |
| 41 | 10 | 0 | 0 | 0 | 2 | 12 |
| 42 | 0 | 0 | 0 | 0 | 5 | 5 |
| 43 | 2 | 1 | 0 | 10 | 9 | 22 |
| *Totals* | 1345 | 352 | 369 | 1243 | 1031 | 4340 |

# Appendix H

# Recommended Definitions and Design Standards for Subdivision Ordinances

**Definitions**

***Streets and Roads***

*Rural Roads*

1. Principal Arterial: A rural link in a highway system serving travel, and having characteristics indicative of substantial statewide or interstate travel and existing solely to serve traffic. This network would consist of Interstate routes and other routes designated as principal arterials.
2. Minor Arterial: A rural roadway joining cities and larger towns and providing intrastate and inter-county service at relatively high overall travel speeds with minimum interference to through movement.
3. Major Collector: A road which serves major intra-county travel corridors and traffic generators and provides access to the Arterial system.
4. Minor Collector: A road which provides service to small local communities and traffic generators and provides access to the Major Collector system.
5. Local Road: A road which serves primarily to provide access to adjacent land, over relatively short distances.

*Urban Streets*

1. Major Thoroughfares: Those thoroughfares consisting of Interstate, Intrastate, other freeway, expressway, or parkway roads, and major streets that provide for the expeditious movement of high volumes of traffic within and through urban areas.
2. Minor Thoroughfares: Those thoroughfares that perform the function of collecting traffic from local access streets and carrying it to the major thoroughfare system. Minor thoroughfares may be used to supplement the major thoroughfare system by facilitating minor through traffic movements and may also serve abutting property.
3. Local Street: Any street not on a higher order urban system that serves primarily to provide direct access to abutting land.

*Specific Type Rural or Urban Streets*

1. Freeway, Expressway, or Parkway: Divided multilane highways designed to carry large volumes of traffic at higher speeds. A freeway provides for continuous flow of vehicles with no direct access to abutting property and with access to selected crossroads only by way of interchanges. An expressway is a facility with full or partial control of access and generally one with grade separations at major intersections. A parkway is for non-commercial traffic, with full or partial control of access.
2. Residential Collector Street: A local street which serves as a connector street between local residential streets and the thoroughfare system. Residential collector streets typically collects traffic from 100 to 400 dwelling units.
3. Local Residential Street: Cul-de-sacs, loop streets less than 750 m in length, or streets less than 1.5 km in length that do not connect thoroughfares, or serve

major traffic generators, and do not collect traffic from more than 100 dwelling units.

4. Cul-de sac: A short street having only one end open to traffic and the other end being permanently terminated and a vehicular turn-around provided.
5. Frontage Road: A road that is parallel to a partial or full access controlled facility and provides access to adjacent land.
6. Alley: A strip of land, owned publicly or privately, set aside primarily for vehicular service access to back sides of properties otherwise abutting on a st.

***Property***

*Building Setback Line*

A line parallel to the street in front of which no structure shall be erected.

*Easement*

A grant by the property owner for use by the public, a corporation, or person(s), of a strip of land for a specific purpose.

*Lot*

A portion of a subdivision, or any other parcel of land, which is intended as a unit for transfer of ownership or for development or both. The word "lot" includes the words "plat" and "parcel".

***Subdivision***

*Subdivider*

Any person, firm, corporation or official agent thereof, who subdivides or develops any land deemed to be a subdivision.

*Subdivision*

All divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose (immediate or future) of sale or building development and all divisions of land involving the dedication of a new street of change in existing streets. The following shall not be included within this definition not subject to these regulations:

1) The combination or re-combination of portions of previously platted lots where the total number of lots is not increased and the resultant lots are equal to or exceed the standards contained herein.
2) the division of land into parcels greater than four hectares where no street ROW dedication is involved
3) the public acquisition (by purchase) of strips of land for the widening or the opening of streets
4) the division of a tract in single ownership whose entire area is no

greater than 0.8 hectares into not more than three lots, where no street ROW dedication is involved and where the resultant lots are equal to or exceed the standards contained herein.

*Dedication*
A gift, by the owner, of his property to another party without any considerations being given for the transfer. The dedication is made by written instrument and is completed with an acceptance.

*Reservation*
Reservation of land does not involve any transfer of property rights. It constitutes an obligation to keep property free from development for a stated period of time.

## DESIGN STANDARDS

### *Streets and Roads*

The design of all roads within the Oak Island area shall be in accordance with the accepted policies of the NCDOT, Department of Planning and Environmental as taken or modified from the American Association of State Highway Officials' (AASHTO) manuals.

The provision of street ROW shall conform and meet the recommendations of the Lillington Thoroughfare Plan. The proposed street layout shall be coordinated with the existing street system of the surrounding area. Normally, the proposed streets should be the extension of existing streets if possible.

***Right-of-way Widths***
ROW widths shall not be less than those shown in Table 15 and shall apply except in those cases where ROW requirements have been specifically set out in the Thoroughfare Plan.

The subdivider will only be required to dedicate a maximum of 30 meters of ROW. In cases where the desired ROW is more than 30 meters, the subdivider will be required only to reserve the amount in excess of 30 m. In all cases in which ROW is sought for a fully controlled access facility, the subdivider will only be required to make a reservation. It is strongly recommended that subdivisions provide access to properties from internal streets, and that direct property access to major thoroughfares, principle and minor arterials, and major collectors be avoided. Direct property access to minor thoroughfares is also undesirable.

A partial width ROW (not less than 18 m in width) may be dedicated when adjoining undeveloped property that is owned or controlled by the subdivider; provided that the width of a partial dedication be such as to permit the installation of such facilities as may be necessary to serve abutting lots. When the said adjoining property is subdivided, the remainder of the full required ROW shall be dedicated.

**Table 15**
**Minimum Right-of-Way Requirements**

| Area Classification | Functional Classification | Minimum ROW(m) |
|---|---|---|
| Rural | Principal Arterial | Freeways: 105 |
| | | Other: 60 |
| | Minor Arterial | 30 |
| | Major Collector | 30 |
| | Minor Collector | 24 |
| | Local Road[1] | 18 |
| Urban | Major Thoroughfare | 27 |
| | Minor Thoroughfare | 21 |
| | Local Street[1] | 18 |
| | Cul-de-Sac[2] | Variable |
| | | |

[1]The desirable minimum ROW is 18.3 m. If curb and gutter are provided, 15 m of ROW is adequate on local residential streets.
[2]The ROW dimension will depend on radius used for vehicular turnaround. Distance from edge of pavement of turnaround to ROW should not be less than distance from edge of pavement to ROW on street approaching turnaround.

***Street Widths***
Street and road classification widths other than local shall be as the Thoroughfare Plan recommends. Local roads and streets width shall be as follows:

1) *Local Residential*
Curb-and-gutter section: 7.9 m, face to face of curb
Shoulder section: 6.1 m to edge of pavement, 1.2 m for shoulders

2) *Residential Collector*
Curb-and-gutter section: 10.4 m, face to face of curb
Shoulder section: 6.1 m to edge of pavement, 1.8 m for shoulders

*Geometric Characteristics*
The standards outlined below shall apply to all subdivision streets proposed for addition to the State Highway System or Municipal Street System. In cases where a subdivision is sought adjacent to a proposed thoroughfare corridor, the requirements of dedication and reservation discussed under ROW shall apply.

1) *Design Speed*: The design speed for a roadway should be a minimum of 10 kph (5 mph) greater than the posted speed limit. The design speeds for subdivisions type streets are shown in Table 16.

**Table 16**
**Design Speeds (in kph)**

| **Facility Type** | **Desirable Speed** | **Minimum Speed** | |
|---|---|---|---|
| | | **Level** | **Rolling** |
| **Rural Roads** | | | |
| Minor Collector | 100 | 81 | 65 |
| Local[1] | 80 | 81 | 65 |
| **Urban Roads** | | | |
| Major Thoroughfare[2] | 100 | 81 | 65 |
| Minor Thoroughfare | 100 | 81 | 65 |
| Local Street | 65 | 65 | 48 |

2) *Maximum and Minimum Grades*:
   a) The maximum grades in percent are shown in the following table.
   b) Minimum grade should not be less than 0.5%.
   c) Grades for 30 meters each way from intersections (measured from edge of pavement) should not exceed 5%.
   d) For streets and roads with projected annual average daily traffic less than 250 vpd, short grades (less than 152 meters in length) may be 150% of the value in Table 17.

Table 17
Maximum Vertical Grade

| Facility Type | Design Speed (kph) | Minimum Grade in Percent: Flat | Rolling | Mountainous |
|---|---|---|---|---|
| **Rural** | | | | |
| Minor Collector Rds[1] | 30 | 7 | 10 | 12 |
| | 50 | 7 | 9 | 10 |
| | 65 | 7 | 8 | 10 |
| | 80 | 6 | 7 | 9 |
| | 100 | 5 | 6 | 8 |
| | 110 | 4 | 5 | 6 |
| Local Roads[1,2] | 30 | N/A | 11 | 16 |
| | 50 | 7 | 10 | 14 |
| | 65 | 7 | 9 | 12 |
| | 80 | 6 | 8 | 10 |
| | 100 | 5 | 6 | N/A |
| **Urban** | | | | |
| Major Thoroughfares[3] | 50 | 8 | 9 | 11 |
| | 65 | 7 | 8 | 10 |
| | 80 | 6 | 7 | 9 |
| | 100 | 5 | 6 | 8 |
| Minor Thoroughfares[1] | 30 | 9 | 12 | 14 |
| | 50 | 9 | 11 | 12 |
| | 65 | 9 | 10 | 12 |
| | 80 | 7 | 8 | 10 |
| | 100 | 6 | 7 | 9 |
| | 110 | 5 | 6 | 7 |
| Local Streets[1] | 30 | N/A | 11 | 16 |
| | 50 | 7 | 10 | 14 |
| | 65 | 7 | 9 | 12 |
| | 80 | 6 | 8 | 10 |
| | 100 | 5 | 6 | N/A |

[1]For streets and roads with projected annual average daily traffic less than 250 vpd or short grades less than 150 meters, grades may be 2% steeper than the values shown in Table 17. (Reference: NCDOT Roadway Metric Design Manual, page 1-12, T-3)
[2]Local Roads include Residential Collectors and Local Residential.
[3]Major Thoroughfares other than Freeways or Expressways.

3) *Minimum Sight Distance*: In the interest of public safety, no less than the minimum sight distance applicable shall be provided. Vertical curves that connect each change in grade shall be provided and calculated using the parameters shown in Table 218.

**Table 18**
**Sight Distances**

| **Design Speed (kph)** | 50 | 65 | 80 | 100 |
|---|---|---|---|---|
| **Stopping Sight Distance** | | | | |
| Minimum | 61 | 84 | 122 | 160 |
| Desirable Minimum | 61 | 99 | 145 | 198 |
| **Minimum K[1] Value for:** | | | | |
| Crest Curve | 9 | 24 | 49 | 95 |
| Sag Curve | 12 | 21 | 34 | 49 |

Note: General practice calls for vertical curves to be multiples of 10 meters. Calculated lengths shall be rounded up in each case.
Minimum passing distance for a 2-lane road is currently under revision.
(Reference: NCDOT Roadway Metric Design Manual page 1-12, T-1)
[1]K is a coefficient by which the algebraic difference in grade may be multiplied to determine the length in meters (in feet) of the vertical curve which will provide the desired sight distance.

4) Superelevation: Table 19 shows the minimum radius and the related maximum superelevation for design speeds. The maximum rate of roadway superelevation (e) for rural roads with no curb and gutter of 0.08. The maximum rate of superelevation for urban streets with curb and gutter is 0.06, with 0.04 being desirable.

**Table 19**
**Superelevation Table**

| **Design Speed (kph)** | **Minimum Radius of Maximum e[1]** | | |
|---|---|---|---|
| | **e = 0.04** | **e = 0.06** | **e = 0.08** |
| 50 | 100 | 90 | 80 |
| 65 | 175 | 160 | 145 |
| 80 | 280 | 250 | 230 |
| 100 | 490 | 435 | 395 |

[1]e = rate of roadway superelevation, m/m (ft/ft)
Reference: NCDOT Roadway Design Manual, page 1-12, T-6 through T-8

*Intersections*

1) Streets shall be laid out so as to intersect as nearly as possible at right angles, and no street should intersect any other street at an angle less than sixty-five (65) degrees.
2) Property lines at intersections should be set so that the distance from the edge of pavement, of the street turnout, to the property line will be at least as great as the distance from the edge of pavement to the property line along the intersecting streets. This property line can be established as a radius or as a sight triangle. Greater offsets from the edge of pavement to the property lines will be required, if necessary, to provide sight distance for the stopped vehicle on the side street.
3) Offset intersections are to be avoided. Intersections which cannot be aligned should be separated by a minimum length of 60 meters between survey centerlines.

*Cul-de-Sacs*

Cul-de-sacs shall not be more than one-hundred fifty (150) meters in length. The distance from the edge of pavement on the vehicular turnaround to the ROW line should not be less than the distance from the edge of pavement to ROW line on the street approaching the turnaround. Cul-de-sacs should not be used to avoid connection with an existing street or avoid the extension of an important street.

*Alleys*

1) Alleys shall be required to serve lots used for commercial and industrial purposes except that this requirement may be waived where other definite and assured provision is made for service access. Alleys shall not be provided in residential subdivision unless necessitated by unusual circumstances.
2) The width of an alley shall be at least 6.0 meters.
3) Dead-end alleys shall be avoided where possible, but if unavoidable, shall be provided with adequate turnaround facilities at the dead-end as may be required by the Planning Board.

*Permits For Connection To State Roads*

An approved permit is required for connection to any existing state system road. This permit is required prior to any construction on the street or road. The application is available at the office of the District Engineer of the NCDOT.

*Offsets To Utility Poles*

Poles for overhead utilities should be located clear of roadway shoulders, preferably a minimum of at least 9.0 meters from the edge of pavement. On streets with curb and gutter, utility poles shall be set back a minimum distance of 1.8 meters from the face of curb.

*Wheelchair Ramps*
All street curbs being constructed or reconstructed for maintenance purposes, traffic operations repairs correction of utilities, or altered for any reason, shall provide wheelchair ramps for the physically handicapped at intersections where both curb and gutter and sidewalks are provided an at other major points of pedestrian flow.

*Horizontal Width on Bridge Deck*
The clear roadway widths for new and reconstructed bridges serving 2-lane, 2-way traffic should be as follows:

1) Shoulder section approach:
    a) Under 800 ADT design year; minimum 8.5 m width, face to face of parapets of rails or pavement width plus 3.1 m, whichever greater.
    b) 800-2000 ADT design year; minimum 10.4 m width, face to face of parapets of rails or pavement width plus 3.7 m, whichever greater.
    c) Over 2000 ADT design year; minimum width of 12.2 m, desirable width of 13.4 m width, face to face to parapets or rails.
2) Curbs and gutter approach
    a) Under 800 ADT design year; minimum 7.3 m face to face of curbs.
    b) Over 800 ADT design year; width of approach pavement measured face to face of curbs. Where curb and gutter sections are used on roadway approaches, curbs on bridges shall match the curbs on approaches in height, in width of face to face of curbs, and in crown drop. The distance from face of curb to face of parapet or rail shall be 0.5 meters minimum, or greater if sidewalks are required.
3) The clear roadway widths for new and reconstructed bridges having 4 or more lanes servicing undivided two-way traffic should be as follows:
    a) Shoulder section approach: Width of approach pavement plus width of usable shoulders on the approach left and right. (Shoulder width 2.4 meters minimum, 3.1 meters desirable.)
    b) Curb and gutter approach: Width of approach pavement measured face to face of curbs.

**Table 20**
**Exact Metric Equivalents**

| English Units | Metric Units |
|---|---|
| 1 inch | equals 2.54 centimeters (cm) |
| 1 foot | equals 0.30 meters (m) |
| 1 mile | equals 1.61 kilometers (km) |
| 1 acre[1] | equals 0.40 hectares (ha) |

[1] 1 acre = 43,560 $ft^2$

**Table 21**
**Exact English Equivalents**

| Metric Units | English Units |
|---|---|
| 1 centimeter (cm) | equals 0.39 inches |
| 1 meter (m) | equals 3.28 feet |
| 1 kilometer (km) | equals 0.62 miles |
| 1 hectare (ha) | equals 2.47 acres |

**Table 22**
**NCDOT Metric Roadway Conversions**

| Lane Widths | | Shoulder Widths | |
|---|---|---|---|
| 8 feet | 2.4 m | 1 foot | 0.3 m |
| 9 feet | 2.7 m | 2 feet | 0.6 m |
| 10 feet | 3.0 m | 4 feet | 1.2 m |
| 11 feet | 3.3 m | 6 feet | 1.8 m |
| 12 feet | 3.6 m | 8 feet | 2.4 m |
| 14 feet | 4.2 m | | |